SPOROLOGICAL STUDY OF SEAM VIII IN RANIGANJ COALFIELD, BIHAR (INDIA) — PART-1. DESCRIPTION OF SPORAE DISPERSAE

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ABSTRACT

Seam VIII which is one out of the ten major coal seams of the Raniganj coalfield, Bihar (India) has been sporologically investigated. The *Sporae dispersae* of the seam has been described on the basis of samples from Bankola, Sunkerpore, Jambad Kajora and East Jambad collieries in the eastern part of Raniganj coalfield. The seam is very rich in its spore content consisting of 39 genera and 86 species out of which 2 genera, *Ricaspora* and *Horriditriletes* and 44 species are new. A thorough study of hundreds of specimens of each genus has been made and the variations in different characters noted. By evaluating different combinations of these characters, the species in the different genera have been determined. The importance of these characters in each of the genera has also been discussed in detail.

INTRODUCTION

THE present investigation deals with the study of the *Sporae dispersae* from seam VIII of the Raniganj coalfield belonging to the Raniganj Stage. It is the third uppermost, workable seam of the Raniganj Stage. Locally, this seam is variously named. In the western part it is called Lower Kajora, Raniganj Jemeri, Nega and Borochak seam at various places and in the eastern part it is named as Jambad Bowlah seam. The seam lies about 220 ft. below the Upper Kajora seam (IX) and about 200 ft. above the Bonbahal seam (VII) in the eastern part. It has a thickness of 40 ft. east of Chora Sitalpur fault which gradually reduces to 23 ft. south of Bonbahal and is even less in the area further to the east. Towards the west, Jambad Bowlah seam is thicker and near Parasia it splits into two bands.

For the description of the representative miospores contained in seam VIII, which is the thickest and hence an unmistakable seam in the Raniganj coalfield, samples have been investigated from four collieries, i.e., Bankola, Sunkerpore, Jambad Kajora and East Jambad, 2-3 Km. distant from each other in the eastern part of Raniganj coalfield. The object of this study has been three fold, (i) to find out the morphographic criteria for the delimitation of spore species from a detailed study of quantitative variations met within each genus of the assemblage in the seam, (ii) to find out the average qualitative and quantitative composition of the spore assemblage in the coal seam and (iii) to estimate the nature of lateral and vertical variation in sporological contents within the seam. The present paper evidently deals with the first aspect.

We are thankful to the Council of Scientific & Industrial Research for the financial assistance to run the scheme and Central Fuel Research Institute for the material.

MATERIAL AND METHODS

The material for the present investigation was collected by the Fuel Research Institute, Jealgora (Bihar), from the following locations:

Bankola Colliery

a) Top section — in No. 2 level in No. 2 drift area.
b) Top of bottom section in No. 3 level (North).
c) Bottom of bottom section in 2nd rise off 17th level.

Sunkerpore Colliery

16th rise, Main west level of No. 5 pit.

Jambad Kajora Colliery

No. 4 North drift, in the junction of No. 5 North level and No. 1 West rise.

East Jambad Colliery

Between 4th-5th level, 6th rise, North of pit No. 4.

The procedure for the collection of coal samples was followed as detailed by Bharadwaj (1962).

Maceration — The procedure followed by us has already been described by Bharadwaj (1962). A graphic representation of the various steps is given in Text-Fig. 1.

Identical procedure of sampling and maceration was followed for all the collieries. In Sunkerpore, Jambad Kajora and East Jambad collieries the sampling was done at one spot each but in Bankola colliery the whole section of the seam was collected from three different spots (*see* BHARAD. 1962; MAP. 1). In all, 46 samples (10 samples from Bankola and 12 samples each from Sunkerpore, Jambad Kajora and East Jambad collieries) were collected and studied.

TAXONOMIC APPROACH

The *Sporae dispersae* represented in the coals of seam VIII (Jambad Bowlah) belonging to the Raniganj Stage (Upper Permian) consists of a large variety of trilete, monolete, monosaccate and disaccate miospores referable to a number of spore genera most of which have been described and illustrated by Bharadwaj (1962) from this horizon. Two new genera described in this paper have been distinguished from the already known ones on the basis of certain qualitative characters. The genera have been arranged according to the scheme of Potonié (1956, 1958, 1960).

The species referred to the spore genera in the present work are based upon the careful analysis of the quantitative characters in each genus. Specimens purporting to form a homogeneous, smallest taxon have been studied in detail and designated as a species. In certain cases some minor qualitative variations have also been considered along with the quantitative ones to delimit species in a genus.

The characters that have been considered important in some of the spore genera for the delimitation of species are as under:

In *Eupunctisporites*, the thin or thick exine, obscure or clear nature of the Y-mark, size of the puncta and their close or sparse distribution are the characters considered important for the separation of species.

In *Calamospora*, for the separation of species, the characters like the overall spore size, length of the Y-rays, thick or thin labra and the presence or absence of an inner body are considered important.

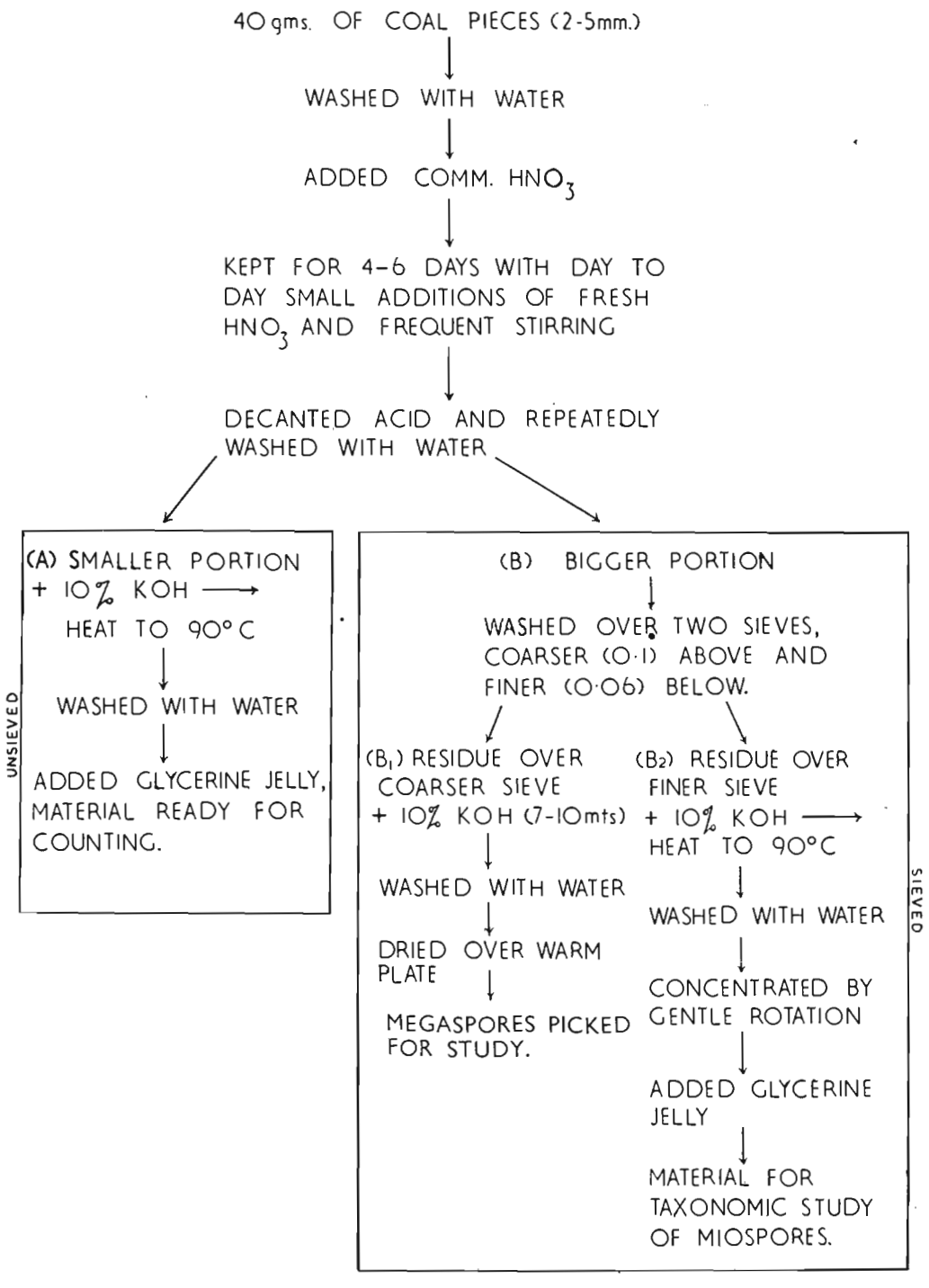
In *Cyclogranisporites* two species, *C. gondwanensis* and *C.* sp., are described. The delimitation of these species is based on characters like the prominent or obscure nature of the Y-mark, size of the grana and their close or sparse arrangement.

In *Lophotriletes* differences have been observed in the overall spore size, length of the Y-arms, nature and arrangement of the ornamentational elements and these form the basis of specific delimitation in this genus. *L.* sp., has very small, closely set coni with pointed tips and has the Y-arms almost reaching the equatorial margin. *L. rectus* is smaller in size and bears small, sparsely set coni with blunt tips and the Y-rays are 3/4 the radius long. Cf. *L. pseudogranus* is bigger than *L. rectus*, has longer coni with sharp to blunt tips and the Y-arms almost reach the equatorial margin. Unlike any of the above species, Cf. *L. rarus* has a distinct interradial thickening and the Y-arms are 1/2-2/3 the radius long.

Horriditriletes is a new genus recorded in the present study. It consists of triangular miospores mostly with long and cylindrical (equally broad throughout) bacula. Here the overall spore size, size and arrangement of the ornamentational elements and the length of the Y-arms are the characters considered important in the delimitation of different species. *H. curvibaculosus* has a distinctly triangular shape with straight sides, Y-rays 2/3 radius long and the bacula being slightly curved are 3-4 μ long. *H.* sp., has 6 μ long and up to 3 μ broad bacula. In *H. brevis* the shape is roundly triangular with distinctly convex sides, bacula very small and closely set and the Y-arms almost reaching the equatorial margin.

In *Cyclobaculisporites* the overall size, distinct or indistinct nature of the Y-mark and the size of the bacula are the characters considered important for specific delimitation.

In *Indospora* the spores have been separated on the basis of the exine ornamentation, length of the Y-arms and the number of meshes which are formed on the distal face. *I. laevigata* has a distinctly laevigate exine, Y-arms 2/3 radius long and the distal muri forming none to only one mesh.



TEXT-FIG. 1 — A graphic representation of the maceration procedure.

I. macula stands quite apart from the above species in having 6-10 polygonal meshes on the distal side, Y-arms 3/4 the length of the radius and the exine is covered with both grana and bacula. *I.* sp., has Y-rays almost reaching the equatorial margin, exine covered with small coni and grana and distally the muri forming none to two meshes.

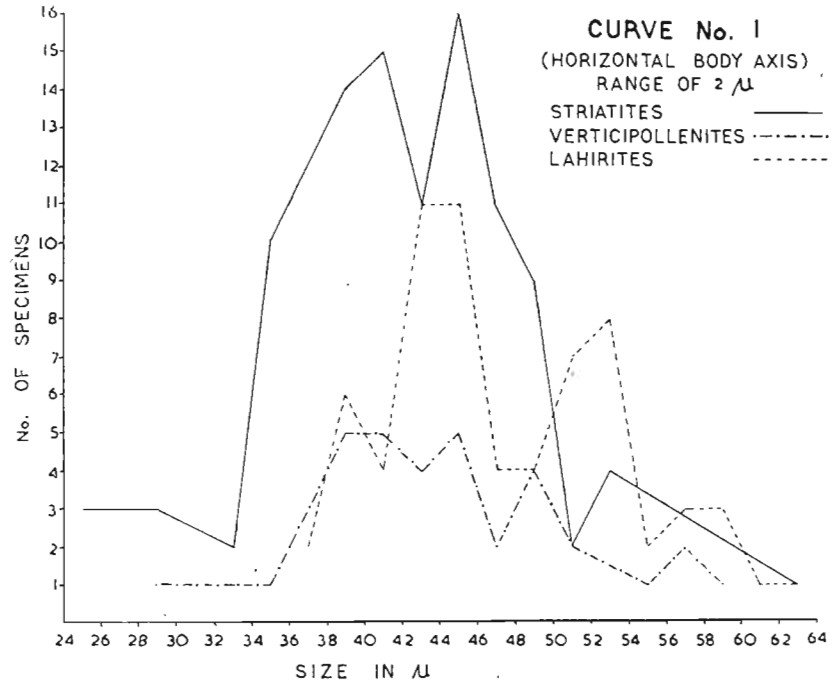
In *Latosporites* the overall size, exine ornamentation and the presence or absence of the striations on the exine are the characters valued here for specific delimitation.

The species of *Nuskoisporites* recorded here are, Cf. *N. triangularis* and Cf. *N. reticulatus*. For the delimitation of these two species, characters like the equal or unequal Y-arms, the body and the saccus ornamentation have been considered important. The rays of the Y-mark are equal in Cf. *N. reticulatus* but unequal in Cf. *N. triangularis*; body ornamentation is granulose in Cf. *N. triangularis* and reticuloid in Cf. *N. reticulatus* and the saccus intrareticulation is very fine in Cf. *N. reticulatus* as compared to that of Cf. *N. triangularis*.

In *Densipollenites* the different species have been separated on the basis of thick, thin and prominent, illdefined or indistinct nature of the central body. *D.* sp., has a thick, dark brown central body. *D. indicus* has a thin, transparent central body while it is almost indistinct in the case of *D. invisus*.

In the genera *Striatites*, *Verticipollenites* and *Lahirites* variations in the thickness of the wall, shape, length of horizontal and vertical axes of the central body, marginal ridge, number of horizontal striations and the vertical partitions inbetween them, shape of the sulcus, lateral distance between the bladders and saccus intrareticulation were noted. To elucidate the number of categories in some of these variable characters curves were drawn and the modes determined.

A look at curve No. 1 representing the horizontal body axis in the aforesaid disaccate genera shows that in *Striatites* the horizontal body axis ranges from 25-63 μ. It shows a very distinct mode at 41 μ. This curve after reaching the lowest point at 51 μ again rises up to 53 μ, where from it starts falling down thereby reaching at 63 μ. In *Verticipollenites* the range in the horizontal body axis is 29-59 μ, showing two modes, one at 40 μ and the other at 49 μ. In *Lahirites*, the range observed is from 37 μ to 63 μ. It shows two very



distinct modes at 44 μ and 53 μ respectively.

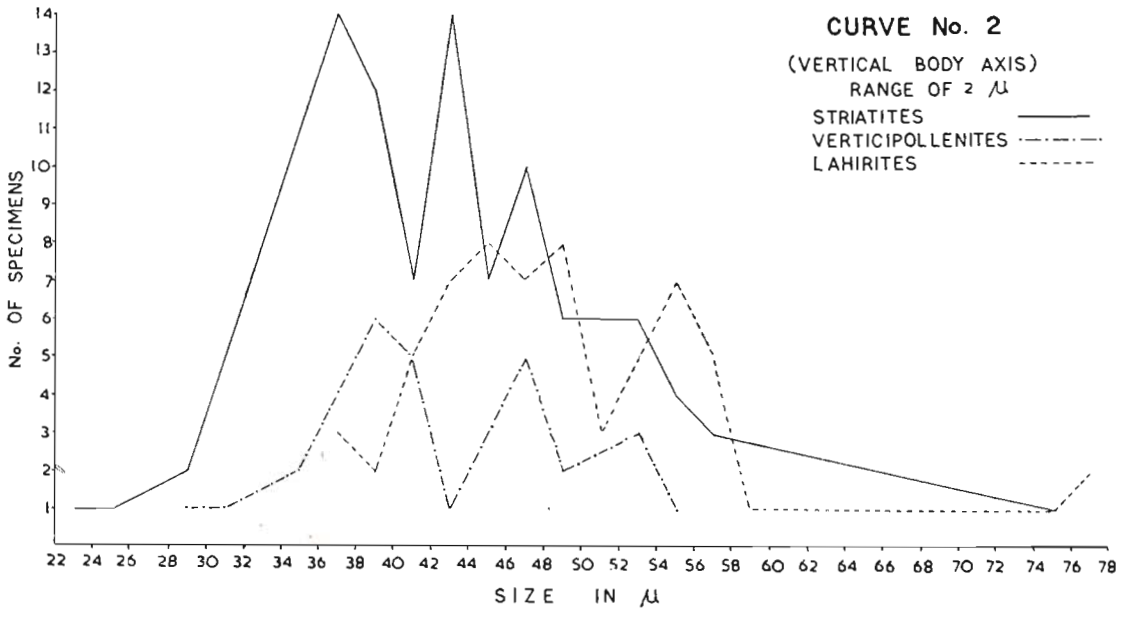
Vertical body axis in the above genera has been represented in curve No. 2. The ranges in the vertical body axes in *Striatites*, *Verticipollenites* and *Lahirites* are 23-75 μ, 29-55 μ and 37-77 μ respectively. In each of these genera, two distinct modes are observed. Modes in *Striatites* are represented in the curve at 37 μ and 43 μ. Slight rise in this curve is also observed at 47 μ, but that is too small to represent another mode. *Verticipollenites* also shows two modes, one at 39 μ and the other at 47 μ. Likewise, *Lahirites* also shows two very distinct modes at 45 μ and 55 μ respectively.

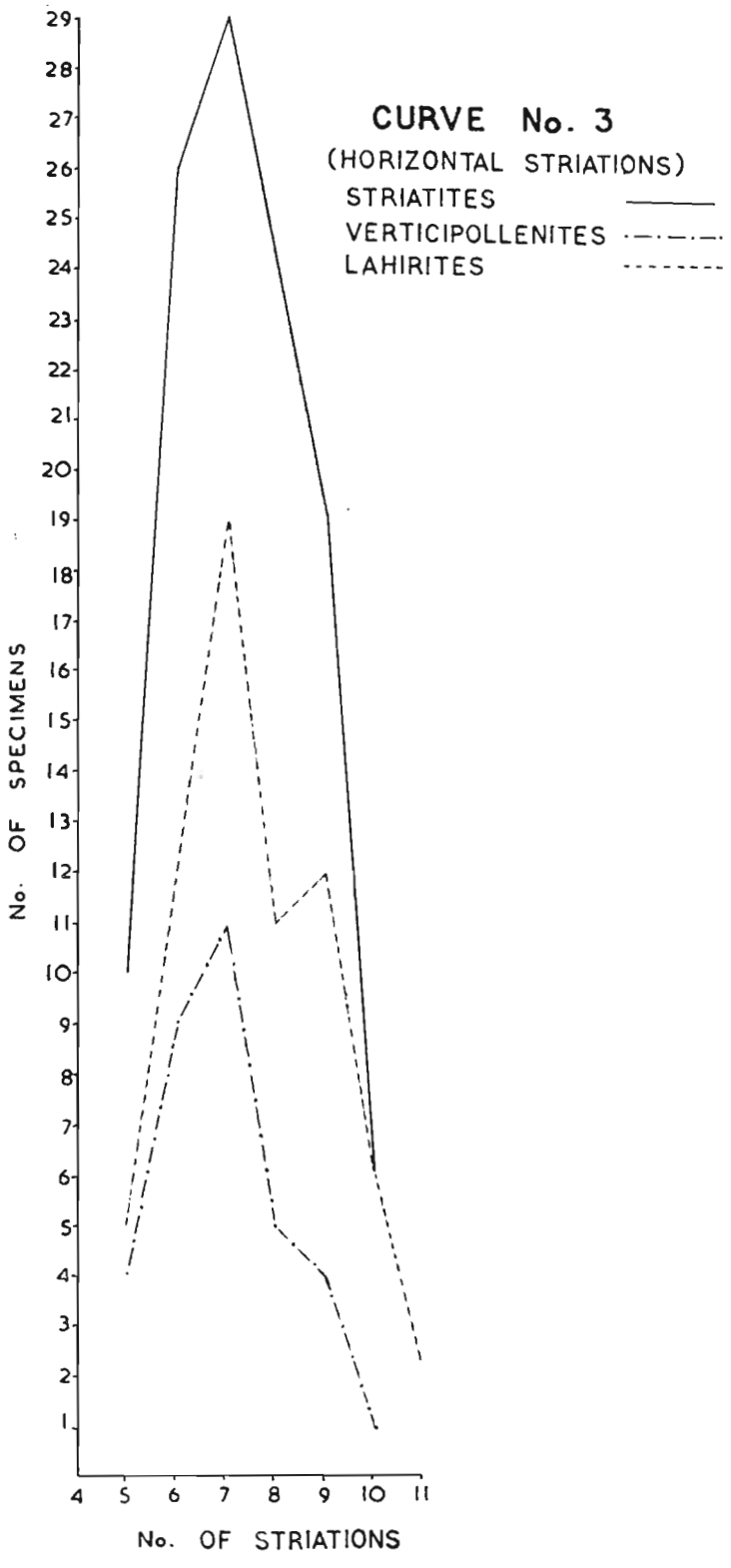
In curve No. 3 representing the horizontal striations in the three genera, only one mode each at 7 is observed.

Curve No. 4 denotes the range and modes represented by the vertical partitions in the genera *Striatites*, *Verticipollenites* and *Lahirites*. It is observed that in all these cases a single distinct mode is seen, that of *Striatites* and *Lahirites* at 3 and of *Verticipollenites* at 4. In all these genera, some specimens with as many as 17-30 vertical partitions are also observed which have also been plotted here. But since the number of such specimens is too low, none of the genera shows as distinct a mode as in the case of specimens with 2-9 vertical partitions.

The range in the lateral sulcus width in the three genera is plotted in curve No. 5. Here *Striatites* shows two modes, one at 7 and the other at 10. Another very weak mode is also observed at 12, which in our opinion does not deserve to be a independent mode. *Verticipollenites* shows two distinct modes at 8 and 10 respectively. Likewise *Lahirites* also shows two distinct modes, one at 5 and the other at 10. Thus two modes in the lateral sulcus width in each of these genera have been observed.

Along with the list of characters employed for delimiting the various species in the disaccate genera, differences in the arrangement of the structural elements in intrapunctate forms like *Lahirites* and *Hindipollenites* have also been observed. In some of the specimens the puncta are uniformly arranged over the whole exine and there are some others where the puncta are coarse and lie in the centre of the interstriated region leaving ± 1 μ wide space on either side. The former has been




CURVE No. 3
(HORIZONTAL STRIATIONS)
STRIATITES
VERTICIPOLLENITES
LAHIRITES
No. OF SPECIMENS
No. OF STRIATIONS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
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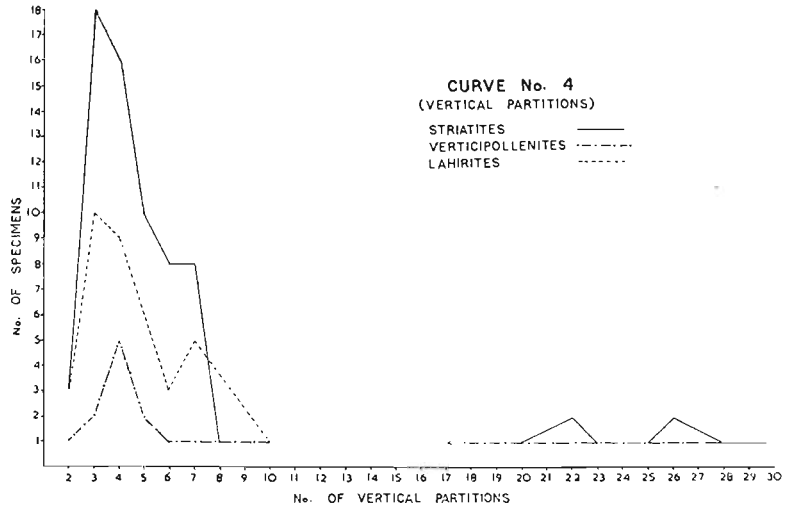
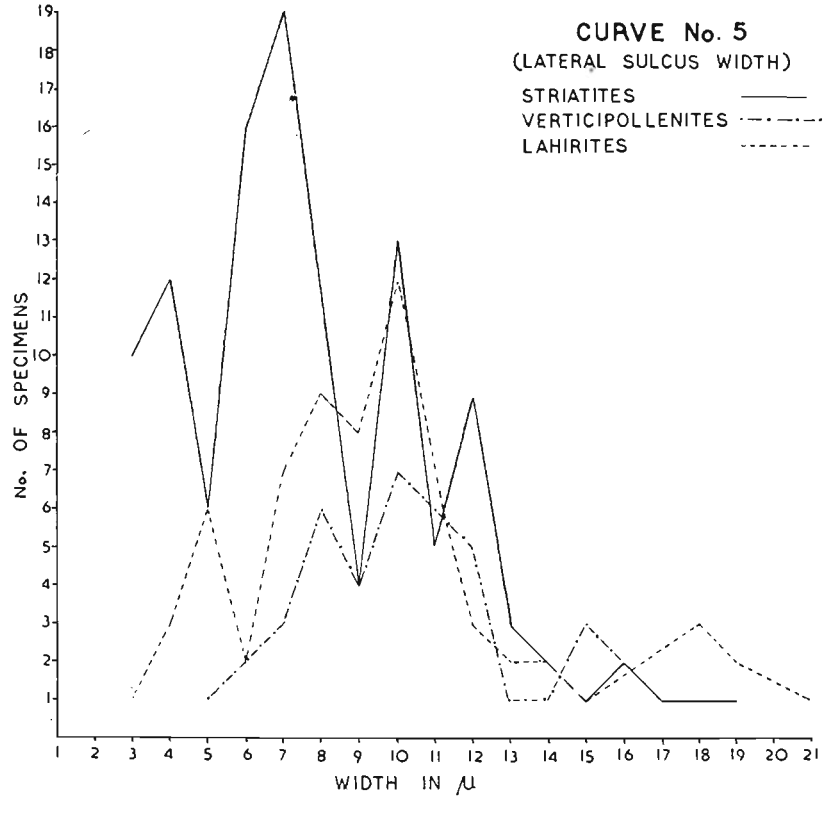
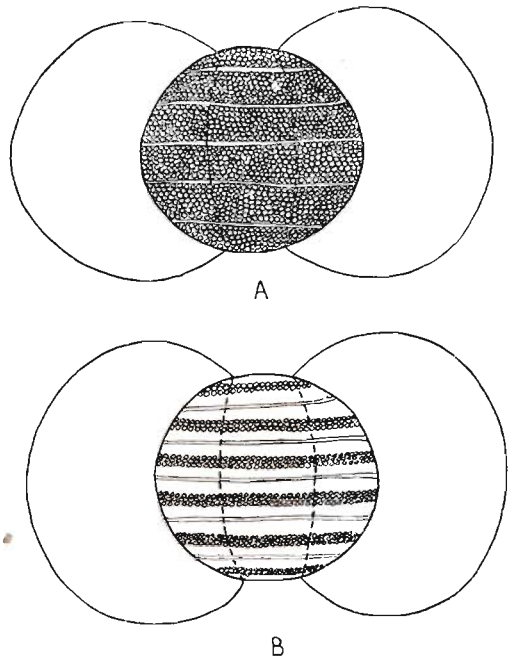




referred as the *uniformly*, and the latter as the *restrictedly* intrapunctate forms (TEXT-FIG. 2).

The bladder intrareticulation has also been considered important in the separation of the different species. It may be "*small*" when the range in size per mesh is 0·5 to 1·0 μ, "*medium*" when it varies from 1 to 2 μ and "*big*" when the range is 2 to 4 μ.



TEXT-FIG. 2 — Showing the arrangement of puncta in the disaccate forms. (A) *Uniform* and (B) *Restricted* arrangement.

The species in *Lunatisporites* have been separated mainly on the basis of the shape and size of the central body and the shape of the sulcus or the saccus-free area. Body exine in all the specimens of *Lunatisporites* is intramicroreticulate. *L. fuscus* is characterized by a vertically oval central body with a distinctly biconvex sulcus and the presence of two ledges at the lateral sides where the two sacci meet. *L.* sp. A, is distinguished by having a vertically oval central body, a biconvex sulcus but without any lateral ledges. *L.* sp. B, has a vertically oval central body and a boat shaped (narrow at one end and broader at the other) saccus-free area.

In *Striatopodocarpites* the characters that proved helpful in the delimitation of the various species are the size and shape of the central body, its prominent or less prominent outline, number of horizontal striations and the width of the distal saccus-free area. *S.* sp. A, has a vertically elongated to rhomboidal central body, proximally with 6 to 8 horizontal striations and the distal saccus-free area up to 18 μ wide. *S.* sp. B, has a vertically oval central body which is longer than the vertical height of the bladders, proximally bearing 8 to 12 horizontal striations. *S. magnificus* has a circular to subcircular central body with 8 to 10 proximal horizontal striations and having the widest (± 25 μ) saccus-free area. *S. diffusus* has a thick, hexagonal central body without a sharply defined outline, proximally bearing 8 to 11 horizontal striations. *S. decorus* also has a hexagonal body but with a thin exine bearing only 6 to 8 striations.

Faunipollenites shows a large variation in its characters. Here, the overall shape of the pollengrains, shape of the central body and the number of horizontal striations have been considered important in the separation of the different species. *F. varius* has a horizontally bilateral shape and the body bears only 6 to 8 horizontal striations proximally. *F.* sp. A, has a roundly bilateral shape and the horizontal striations on the proximal face of the body number 9 to 12.

The genus *Striapollenites* is characterized by having only vertical striations and no horizontals. In the delimitation of the species stress has been laid here on the overall appearance, shape of the central body and the number of vertical striations. *S. saccatus* is distinctly bilateral with two independent bladders and usually 6-7 striations on the proximal face of the body. *S.* sp., has a monosaccate like tendency with a notch on one of the lateral sides. *S. obliquus* has a spindle oval central body bearing 10 to 15 vertically oblique striations on its proximal face.

Another genus *Distriatites* is characterized by having horizontal striations on one face and vertical striations on the other side of the central body. Here the overall appearance of the pollengrains, shape of the body, number and nature of the vertical as well as the horizontal striations are considered important. One of the species referred to as *D. insolitus* is distinctly diploxylonoid with a broadly oval to subcircular central body and the two types of striations are straight and almost perpendicular to each other. Another single but interesting specimen has been recovered which has horizontal striations on one face of the central body and vertically oblique striations with cross partitions on the other. It has been described as *Distriatites* sp.

In *Sulcatisporites* the overall shape, size of the pollengrains and the extent of ill-defined nature of the central body are the characters which have been given importance in the separation of different species. *S.* sp. A, is horizontally bilateral, has darkened central body with a diffused outline. *S.* sp. B, is circular to subcircular and the body is hardly seen. *S. ovatus* is smaller in size, broadly oval to subcircular in shape and has a faint, vertically oval central body.

In *Welwitschiapites* the variations in the overall shape and size of the pollengrains, number and nature of striations have been considered important for the delimitation of the various species. *W. tenuis* is vertically longish bearing 6 to 10, usually anastomosing striations. *W. extansus* is almost subcircular in shape, much smaller in size than *W. tenuis* and bears 6 to 8 striations which rarely bifurcate.

SYSTEMATIC DESCRIPTION

Anteturma — *Sporites* H. Pot. 1893
Turma — *Triletes* (Reinsch) Pot. & Kr. 1954
Subturma — *Azonotriletes* Luber 1935
Infraturma — *Laevigati* (B. & K.) Pot. 1956

Leiotriletes (Naum.) Pot. & Kr. 1954

Leiotriletes sp.

Pl. 1, Fig. 1

Description — Overall shape triangular with rounded to lobed angles and straight to concave or slightly convex sides, the former being more common. Size range 27-42 μ. Y-mark prominent, arms going up to the equatorial margin or ending before, with low apex and vertex and thin labra. Exine laevigate to infrapunctate, presence of folds in almost all the specimens observed, suggestive of the exine being not thick. *Extrema-lineamenta* laevigate.

Comparison — From the Lower Gondwanas the other species described is *Leiotriletes directus* by Balme and Hennelly (1956b) which has been transferred by Bharadwaj (1962) to *Microfoveolatispora*. Spores described as D_1 & D_3 by Ghosh and Sen (1948; Pl. 4, Figs. 19-22) perhaps belong to *Leiotriletes*, the size range given by them is 31-44 μ for D_1 and 31 μ for D_3, which almost approach the size range of *L.* sp. The specimens designated as D_1 by Ghosh and Sen (1948; Pl. 4, Figs. 19-21) have sides which are straight or slightly curved inwards. In the spores observed by us all variations from inwardly curved to straight or to outwardly bulging sides are metwith. Concave nature of the sides has been clearly shown in the specimen designated as D_3 by the above authors (Ghosh & Sen 1948; Pl. 4, Fig. 22). Spores of D_3 type strongly conform to the spores of modern Sphagnaceae (Knox 1939). Datta includes all the specimens (Datta 1957; Figs. 38-48) with granulose, laevigate, punctate and spinose ornamentations in a single genus *Granulatisporites*. Out of these, two specimens (Datta 1957; Figs. 43-44) appear to have a laevigate exine and measure 38 μ and 42 μ respectively. These compare very well with specimens of *L.* sp., described here.

Among the spores described by Virkki, type 20 (Virkki 1945; Pl. 7, Fig. 101) probably belongs to *Leiotriletes*.

Concavisporites (Pflug 1952; Thomson & Pflug) Delcourt & Sprumont 1955

Cf. *Concavisporites bankolensis* sp. nov.

Pl. 1, Figs. 2-5

Holotype — Pl. 1, Fig. 2.

Diagnosis — Roundly triangular, 30-45 μ. Y-mark distinct, rays going up to 2/3 radius, labra broadly thickened. Exine and *extrema-lineamenta* smooth.

Description — Golden yellow, roundly triangular with straight to concave sides and lobed angles. Holotype 42 μ. Y-mark clearly seen, rays up to 20 μ long with a 2-3 μ wide border running all along the Y-mark and usually also around the ray ends. Exine laevigate.

Comparison — Cf. *Concavisporites bankolensis* compares closely with *Concavisporites* in possessing an interradial thickening along the rays. So far *Concavisporites* is known from Tertiary and its occurrence in Lower Jurassic is also suspected.

Eupunctisporites Bharad. 1962

Eupunctisporites gravus sp. nov.

Pl. 1, Figs. 6-8

Holotype — Pl. 1, Fig. 6.

Diagnosis — Circular, 60-95 μ, Y-mark present, normally obscure but distinct when

open, rays ± 1/2 radius long. Exine ± 4 μ thick in optical section, covered with widely spaced puncta.

Description — Dark brown miospores, generally dense, holotype 78 μ. Y-mark present, generally obscure, clear when open. Exine finely set with less than 2 μ wide, sparsely distributed puncta; exine ± 4 μ thick in optical section; *extrema lineamenta* roughly even.

Comparison — *E. poniatiensis* Bharad., has smaller puncta which are comparatively narrowly spaced and the exine is thinner. The present species distinguishes in possessing sparsely set and broader punctations with a thicker exine and that the trilete mark is obscure.

Remarks — Two of the specimens illustrated here do not show a clear Y-mark, however, its presence is faintly discernible under oil immersion.

Eupunctisporites sp.

Pl. 1, Fig. 9

Description — Dark brown miospore, ± 80 μ. Y-mark prominent. Exine densely covered with ± 1·5 μ broad puncta, irregular in shape and so closely set that 2 or more puncta sometimes fusing to form irregular pits. Punctation very well recognized as depressions on the open margins of the trilete rays and on the *extrema lineamenta*.

Comparison — *Eupunctisporites poniatiensis* has 1 μ wide puncta which are widely spaced leaving a 1-2 μ wide space inbetween them. *E. gravus* has a thick exine with sparser puncta and the trilete mark is generally obscure. The present species distinguishes in having a thinner exine and comparatively many more puncta which are very closely set, sometimes fusing to form irregular pits.

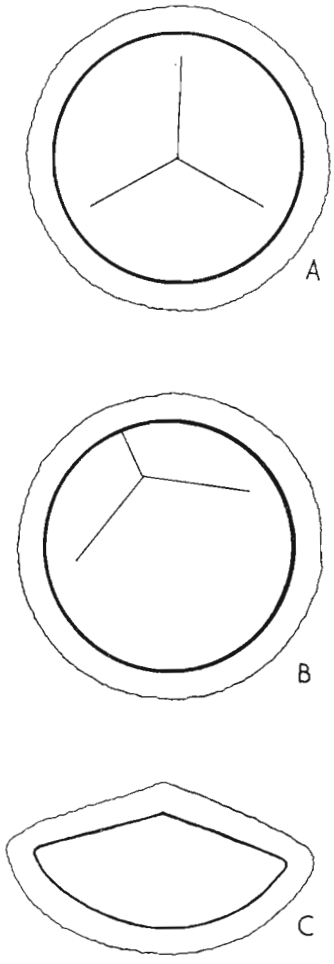
Ricaspora gen. nov.

Generotype — *Ricaspora granulata* sp. nov.

Generic Diagnosis — Trilete miospores, usually circular, enveloped by a perisporial membrane.

Generic Description — Trilete, normally circular miospores with a perisporial envelop which appears as a thin flange in flattened spores. Y-mark prominent, labra thin and low. Exine thick, laevigate.

Reconstruction — Most of the specimens and also two of the illustrated ones are eccentrically flattened, the Y-mark having been shifted to one side. In such cases the Y-mark has shifted but the flange-like rim still maintains its marginal position suggesting thereby that it is not attached to the spore equatorially as a flange should be and thus, is a perisporial covering (TEXT-FIG. 3A-C).



TEXT-FIG. 3 — Organization of *Ricaspora* gen. nov. (A) polar view with the Y-mark in the centre. (B) polar view with the Y-mark shifted to one side. (C) meridional section.

Comparison — *Calamospora, Punctatisporites and Eupunctisporites,* all differ in lacking a perisporial covering. The spore without the perisporial covering is comparable with *Calamospora* and *Punctatisporites*

in possessing laevigate exine. *Eupunctisporites* possesses regular, distinct punctations on the exine and hence is not comparable to *Ricaspora*. *Perotriletes* has a subtriangular body, the exine is beset with coni and lacks a distinct perisporial covering. Almost all the specimens of *Ricaspora* observed by us, are associated with perisporial covering, hence these can not be easily mistaken for any other genus.

The generic name is derived from Rica = Veil. The perisporial covering of the spore looks like a veil.

Ricaspora granulata sp. nov.

Pl. 1, Figs. 10-12

Holotype — Pl. 1, Fig. 10.

Diagnosis — Circular, 60-80 μ; Y-mark distinct, rays going up to 3/4 the radius; apex and vertex low, labra thin. Exine thick, laevigate, enveloped by a thin granulose perisporium.

Description — Golden yellow, usually circular miospores, exhibiting a thin flange like perisporium which is 6-8 μ broad on the equator and granulose in nature. Holotype 80 μ. Y-mark distinct, apex and vertex low, labra thin. Exine ± laevigate, perisporium granulose, thus when viewed under the microscope the granulose nature of the perisporium obscures the laevigate nature of the exine.

Remarks — In one of the specimens illustrated here (Pl. 1, Fig. 12), the perisporial fringe is almost dissolved, only its remnants can be seen here and there attached to the spore body; even in these fragmentary remains its granulose nature is easily made out.

Calamospora S.W. & B. 1944

Calamospora aplata sp. nov.

Pl. 1, Figs. 13-15

Holotype — Pl. 1, Fig. 13.

Diagnosis — Circular, 35-55 μ. Y-mark distinct, rays extending less than 2/3 the radius, ends not tapering. Exine infrapunctate, *extrema lineamenta* smooth.

Description — Yellowish miospores, circular with many irregular folds, which give the spores various derived shapes. Holotype 54 μ. Y-mark distinct, ray ends blunt, rays 1/2 the radius or slightly more long, apex and vertex slightly raised, labra thin. Exine infrapunctate, sometimes with a slight, illdefined, darkening in the interray area (Pl. 1, Fig. 13) in the specimens observed.

Comparison — The spores described as F_1 & F_2 by Ghosh & Sen (1948; Pl. 5, Figs. 47, 48, 49), compare with the present species. For F_1 the size range assigned by Ghosh and Sen (1948; Pl. 5, Figs. 47-48) is 23-29 μ and its Y-mark covers the whole surface of the spore whereas in the specimens described by us the overall size is bigger, viz. 35-55 μ and the arms of the Y-mark are 1/2 radius long or slightly more. However the description of type F_2 by the above authors (Ghosh & Sen 1948; Pl. 5, Fig. 49) almost agrees with *C. aplata*.

Calamospora exila sp. nov.

Pl. 1, Figs. 16-17

Holotype — Pl. 1, Fig. 16.

Diagnosis — Normally circular, 76-110 μ. Y-mark distinct, rays 1/2-3/4 radius long, labra thin, inner body usually apparent as a globular dark area, exine infrapunctate.

Description — Yellowish brown miospores, originally circular with many peripheral folds. Holotype 76 μ. Y-mark present, rays subdued in the folds, almost 1/2 to 3/4 the radius long. Exine infrapunctate, *extrema lineamenta* laevigate. Usually a globular inner body present; in the specimens illustrated here the body is seen as a dark area slightly eccentrically placed with reference to the Y-mark.

Comparison — *Calamospora exila* differs from *C. aplata* in being bigger in size and in having frequently a prominent inner body.

Retusotriletes Naum. 1953

Retusotriletes diversiformis (B. & H.) Bharad. 1962

Pl. 1, Fig. 18

Holotype — Balme & Hennelly 1956b; Pl. 2, Fig. 14.

Diagnosis — Circular, 24-53 μ. Trilete mark prominent, extending up to half the radius, apex and vertex low; contact area well defined as triangular dark areas or delimited by incipient *curvatureae*. Exine very faintly granulose.

For description see Balme & Hennelly 1956b, p. 246.

Infraturma — *Apiculati* (B. & K.) Pot. 1956
***Cyclogranisporites* Pot. & Kr. 1954**

Cyclogranisporites gondwanensis sp. nov.

Pl. 1, Figs. 19-22

Holotype — Pl. 1, Fig. 19.

Diagnosis — Circular, 22-36 μ. Y-rays distinct, almost going up to 3/4 the radius, ray ends not tapering. *Extrema lineamenta* and exine covered with ± 1 μ wide grana.

Description — Yellowish, circular miospores. Holotype 32 μ. Trilete mark distinct, Y-arms generally going up to 3/4 the radius and mostly subdued by the closely set ornamentation, hence in many of the specimens studied, the exact nature of the rays not very well ascertained, although the Y-mark discernible. Apparently in some of the cases two of the arms longer than the third one; however, this feature not appearing to be constant in all the specimens. Exine matted with uniformly set grana, ± 1 μ in size, generally 40-70 grana counted on the equatorial margin. In smaller specimens 40-50 grana on the margin and in the bigger specimens 60-70. In certain cases (PL. 1, FIG. 21) some of the grana confluent.

Comparison — The other Lower Gondwana spore assemblages studied in detail are from Australia by Balme & Hennelly (*loc. cit.*), and by Leschik (1959) from S.W. Africa but they do not record any *Cyclogranisporites*.

From the Indian Gondwana deposits spore types 16 and 23 described by Virkki (1945) are closely comparable with the present species. Spore type 16 (VIRKKI 1945; PL. 3, FIG. 36) measures 40 × 38 μ and has a 3 μ thick wall. Spore type 23 (VIRKKI, 1945; PL. 4, FIG. 41) is round and measures 32-37·5 μ with a thin (± 1 μ) wall. The specimens studied by us agree very nearly in the size and wall thinness with spore type 23 than spore type 16 of Virkki (1945).

Cyclogranisporites sp.

Pl. 1, Figs. 23-24

Description — Light yellow, circular miospores. Y-mark hardly discernible due to its being covered over by the ornamentation. Exine set with ± 1·5 μ broad, distinct grana.

Comparison — *Cyclogranisporites gondwanensis*, besides being smaller in size, has smaller, very closely set grana which sometimes show confluence of the elements. The present species differs in possessing bigger and widely spaced grana.

***Verrucosisporites* (Ibr.) Pot. & Kr. 1954**

Verrucosisporites sp.

Pl. 1, Fig. 25

Description — The specimen observed here is subcircular, measuring 76 μ. Y-mark distinct and generally open with almost equal rays reaching to about 1/2 the radius; labra thick. Exine ornamentation verrucose, verrucae being less than 1 μ high. Only one specimen has been observed.

Comparison — Balme & Hennelly (1956b) have described four species of *Verrucosisporites*, out of which *V. pseudoreticulatus* has been transferred to *Microfoveolatispora* by Bharadwaj (1962). Out of the remaining, none is morphographically comparable to *Verrucosisporites* sp., described here. The only species morphographically comparable to this is *V. donarii* Pot. & Kr., which has comparatively larger verrucae and has been described from the Carboniferous strata of Europe.

***Lophotriletes* (Naum.) Pot. & Kr. 1954**

Lophotriletes rectus sp. nov.

Pl. 2, Figs. 26-28

Holotype — Pl. 2, Fig. 26.

Diagnosis — Triangular, 22-40 μ. Y-mark prominent, rays ± 3/4 radius long, exine beset with small, blunt coni.

Description — Golden yellow, triangular with rounded angles and straight to slightly concave sides. Holotype 33 μ. Y-mark distinct, rays extending to almost 3/4 radius. Exine covered over by blunt tipped coni; coni ± 2 μ long and 1-1·5 μ broad, numbering 8-12 along the *extrema lineamenta*.

Comparison — Balme & Hennelly (1956 b) describe *Acanthotriletes tereteangulatus* which appears to be a representative of *Lophotriletes* and differs from *L. rectus* in having pointed coni and the Y-rays almost reaching the periphery.

Lophotriletes sp.

Pl. 2, Fig. 29

Description — Roundly triangular miospores, 40-56 μ, exine covered with small,

up to 1 μ high and equally broad based, pointed coni so sparsely that similar coni can find place between the existing ones. Y-mark distinct, rays almost reaching the equatorial margin, rarely ending short; apex and vertex of the Y-mark low and labra thin.

Comparison — *L. rectus* is smaller in size and has larger, sparsely distributed coni.

Cf. *Lophotriletes rarus* sp. nov.

Pl. 2, Figs. 30-33

Holotype — Pl. 2, Fig. 30.

Diagnosis — Triangular, 30-42 μ. Y-mark distinct, surrounded by a distinct border thickened along the rays, rays 1/2-2/3 radius long. Exine sparsely covered with very small coni.

Description — Golden yellow miospores, triangular with lobed angles and straight to concave sides. Y-mark distinct, rays going from 1/2-2/3 radius, ending bluntly. A thickened border present following the contour of the Y-mark. Exine and *extrema lineamenta* covered over by ± 1·5 μ long, sparsely set coni; up to 15 coni present on the equatorial margin.

Comparison — The present species differs from the normal species of *Lophotriletes* by possessing a distinct border surrounding the rays. Similar, bordered rays are known from *Concavisporites* but there the exine is always laevigate.

Cf. *Lophotriletes pseudogranus* sp. nov.

Bharad. 1962; Pl. 1, Figs. 29-30

Holotype — Bharad. 1962; Pl. 1, Fig. 29.

Diagnosis — Roundly triangular with prominently convex sides, 44-50 μ. Y-mark almost reaching the equatorial margin. Exine covered by fine up to 2 μ long and 1-2 μ broad, sharp to blunt tipped coni.

Description — Yellowish brown miospores with bulging convex sides, roundly triangular shape being the most common, and sometimes the sides are very much convex so that the spore tends to assume circular shape (BHARAD. 1962; PL. 1, FIG. 30). Holotype 45 μ. Y-mark distinct, rays reaching the *extrema lineamenta*. Exine uniformly and profusely covered with mostly pointed, 1-2 μ broad and up to 2 μ long coni; sometimes coni have rounded tips but such elements are less frequently seen. On the *extrema lineamenta* about 60 coni can be counted.

Comparison — *Lophotriletes rectus* is smaller in size with straight to slightly concave sides and the Y-arms are up to 3/4 radius long. Cf. *L. rarus* differs in having a distinct interradial border. Cf. *L. pseudogranus* distinguishes in possessing a roundly triangular shape with convex sides, profusely ornamented exine with the Y-rays almost reaching the *extrema lineamenta*.

***Horriditriletes* gen. nov.**

Generotype — *Horriditriletes curvibaculosus* sp. nov.

Generic diagnosis — Trilete. triangular miospores, exine beset mostly with bacula.

Generic description — Triangular miospores with straight to slightly curved sides and rounded angles. Y-mark almost always prominent with its rays 1/2-3/4 radius long, ray ends observed blunt in most of the specimens. Exine bearing mostly long, cylindrical (equally broad throughout), longer than broad, bacula on the surface.

Comparison — *Acanthotriletes* is characterized by having long, broad-based and pointed coni. *Neoraistrickia* is roundly triangular with distinct, closely placed bacula and is recorded from the Tertiary of Australia. *Raistrickia* is a distinctly subcircular type with a thick exine. *Lophotriletes* has very small, blunt and closely placed coni. All the specimens of *Horriditriletes* studied here have long, cylindrical, longer than broad, sparsely placed, curved bacula which do not fit in any of the genera referred to above.

The generic name is derived from Horrid = Blunt. *Acanthotriletes ramosus* Balme & Hennelly (1956b) is transferred to *Horriditriletes* as *H. ramosus* (B. & H.) comb. nov.

Horriditriletes curvibaculosus sp. nov.

Pl. 2, Figs. 34-39

Holotype — Pl. 2, Fig. 34.

Diagnosis — Roundly triangular miospores. Y-mark distinct, rays about 2/3 radius long. Exine ornamented with mostly curved, longer than broad bacula.

Description — Spores distinctly triangular with straight to slightly concave sides and broadly rounded angles; convex sides are rather rare. Size 26-40 μ, rays of the Y-mark usually 2/3 the radius, sometimes

when open, almost reaching the equatorial margins; apex and vertex of the Y-mark low, labra thin. Exine ornamented with usually curved bacula, 2-4 μ long, longer than broad and with blunt tips; individual bacula spaced quite wide apart, 7-16 bacula on the *extrema lineamenta*.

Spore described as D_{11}, by Ghosh & Sen (1948; PL. 4, FIG. 31) probably belongs to *Horriditriletes curvibaculosus*.

Horriditriletes brevis sp. nov.

Pl. 2, Figs. 41-42

Holotype — Pl. 2, Fig. 41.

Diagnosis — Roundly triangular miospores with convex sides, 20-24 μ. Y-mark prominent, arms almost reaching the margins. Exine covered by blunt, ± 2 μ long bacula.

Description — Golden yellow, roundly triangular to subcircular miospores, the former shape being more common. Holotype 20 μ. Y-mark generally prominent, but in some cases rendered obscure by the low set, closely packed bacula but when prominent the rays reaching almost up to the *extrema lineamenta*; apex and vertex low, labra thin. Exine ornamented with blunt ± 2 μ long bacula, sometimes bacula not prominently seen on the *extrema lineamenta*, 15-20 bacula at the margin.

Comparison — *Horriditriletes brevis* distinguishes by its smaller size and in possessing shorter bacula as compared to the species described earlier.

Horriditriletes Cf. *H. ramosus* (B. & H.) comb. nov.

Pl. 2, Fig. 43

Description — Spores roundly triangular, ± 45 μ, with a prominent trilete mark whose arms obscured by dense ornamentation. Exine covered with rounded 2-5 μ long and broad-based, blunt bacula, up to 25 in number along the *extrema lineamenta*.

Comparison — The specimen illustrated here closely approaches *H. ramosus* described by Balme & Hennelly (1956b) which has longer and sparser bacula while in the specimen described here the bacula are smaller in size. *H. curvibaculosus* distinguishes from *H.* Cf. *H. ramosus* in possessing long, curved bacula.

Remarks — Since only one well preserved specimen has so far been observed in this coal, we have referred it as *H.* Cf. *H. ramosus*.

Horriditriletes sp. A.

Pl. 2, Fig. 40

Description — Triangular with prominently lobed angular apices and straight to convex or concave sides. Size 26-45 μ, holotype measuring 42 μ. Y-mark distinct, rays about 2/3 the radius, apex and vertex low, labra thin, ray-ends tapering or blunt. Exine sparsely covered by up to 3 μ broad and up to 6 μ long, truncate bacula. In some specimens observed by us the sculptural elements tend to be more at the three angles.

Comparison — *Horriditriletes curvibaculosus* differs from the present species in having smaller, more closely placed and curved sculptural elements. *H. brevis* has smaller spore size and bacula.

Horriditriletes sp. B.

Pl. 2, Fig. 44

Description — Yellowish, roundly triangular miospores with rounded angles and straight to convex sides. Size ± 50 μ. Y-mark distinct, arms equal, ±22 μ long. Exine thick, covered by ± 2 μ broad and equally long, round or truncate-tipped bacula, about 20 bacula present on the equatorial margin.

Comparison — *Horriditriletes curvibaculosus* is smaller in size with few, sparsely arranged curved bacula. *H. brevis* is much smaller in size, subcircular in shape and with the Y-rays reaching the equatorial margin. *H.* sp. A, though approaching the size of the present species, differs in possessing very long baculate processes.

Remarks — Since only one specimen has been recovered by us we have described it as *Horriditriletes* sp.

***Cyclobaculisporites* Bhard. 1955**

Cyclobaculisporites indicus sp. nov.

Pl. 2, Figs. 45-46

Holotype — Bharad. 1962; Pl. 2, Fig. 37.

Diagnosis — Circular, 94-120 μ. Y-mark hardly discernible due to ornamentation. Exine ornamented with up to 2·5 μ broad, closely placed bacula, interbaculate spaces seen as parts of a negative reticulum.

Description — Light brown, circular miospores with peripheral folds. Holotype 94 μ. Y-mark hardly discernible in most of the specimens because it is densely covered with ornamentation, but in certain specimens where the mark is visible, the arms are ± 2/3 radius long. In some of the specimens the Y-rays appear to be equal and in others one being smaller than the other two. Exine uniformly and densely covered over by bacula, up to 2·5 μ broad and equally long forming a negative reticulum due to their close approximation. 96-120 bacula counted on the *extrema lineamenta*.

Comparison — *Cyclobaculisporites grandiverrucosus* (Kos.) Bhard., *C. ovimammus* (Imgr.) Bhard., and *C. sinensis* (Imgr.) Bhard., differ in possessing broader sculptural elements and are known from the Upper Carboniferous of the Saar. *C. trisecatus* (B. & H.) Bharad., differs in possessing distinctly broader, higher and rounded bacula.

Cyclobaculisporites minutus sp. nov.

Pl. 2, Figs. 47-49

Holotype — Pl. 2, Fig. 47.

Diagnosis — Circular to subcircular 40-82 μ. Y-mark prominent, rays ± 1/2 radius long. Exine covered with ± 1·5 μ broad, closely placed bacula.

Description — Yellowish brown, circular to subcircular miospores. Holotype 70 μ. Y-mark clearly seen, rays ± 1/2 radius long; ray-ends usually blunt, pointed ones rare. Exine covered with closely packed ± 1·5 μ broad bacula which number 55-80 on the *extrema lineamenta*.

Comparison — The present species differs from *C. indicus* in being smaller in size and in possessing smaller bacula and a prominent trilete mark.

Infraturma — *Murornati* Pot. & Kr. 1954

***Microfoveolatispora* Bharad. 1962**

Microfoveolatispora sp.

Pl. 2, Fig. 50

Description — Yellowish, triangular with rounded angles and prominently convex sides; Y-mark distinct, rays terminating at or slightly before the equator; tecta generally high and folded, appearing progressively raised from the apex towards the equatorial margin. Exine uniformly covered with low muri forming upto 1μ wide foveolae which are observed on the *extrema lineamenta* as regular depressions.

Comparison — *Microfoveolatispora raniganjensis* and *M. pseudoreticulata*, illustrated by Bharadwaj (1962), have distinctly bigger foveolae.

***Indospora* Bharad. 1962**

Indospora laevigata sp. nov.

Pl. 2, Figs. 51-53

Holotype — Pl. 2, Fig. 51.

Diagnosis — Triangular, 40-54 μ. Y-mark distinct, rays 2/3 radius long. Exine laevigate. Distally muri forming none or only one mesh.

Description — Golden yellow, triangular with straight to slightly curved sides. Holotype 48 μ. Y-mark distinct, rays going upto 2/3 radius. Exine laevigate. Distally muri ± 2 μ wide projecting out at the angular apices and forming none or rarely only one mesh in the centre of the spore.

Comparison — The present species differs from *I. clara* in possessing a laevigate exine.

Indospora macula sp. nov.

Pl. 2, Figs. 54-56

Holotype — Pl. 2, Fig. 54.

Diagnosis — Triangular, 44-60 μ. Y-mark distinct, rays ending slightly before the equator. Exine sparsely covered by few grana and bacula; distally muri forming 6-10 polygonal meshes.

Description — Golden yellow miospores, triangular with rounded angles and straight to slightly concave sides. Holotype 44 μ. Y-mark prominent and usually open, rays terminating slightly before the equator, labra thin. *Extrema lineamenta* at the three angles with small projections continuing distally as muri which form 6-10 polygonal meshes in the centre of the spore. Exine ornamented with sparsely distributed grana and bacula. Muri 2-3 μ broad.

Comparison — *Indospora clara* distinguishes in possessing verruco-baculate exine, bigger size and the meshes on the distal side being 1-4 in number. *I. laevigata* differs in having laevigate exine and only one or no meshes at distal pole. The present

species *I. macula*, distinguishes in possessing 6-10 polygonal meshes on the distal side and in possessing grana and bacula for ornamentation.

Indospora sp.

Pl. 3, Figs. 57-58

Description — Spores light yellow in colour, triangular with rounded angles and straight to slightly curved sides. Y-mark distinct with rays almost reaching the equator. Exine sparsely granulose or bearing small coni. Distally exine traversed by ± 4 μ high muri running from pole to equator of the spore, usually forming 3-8 μ long angular projections. In some cases the muri form one or more meshes in the centre while in others they do not.

Comparison — *Indospora clara* differs in possessing verruco-baculate exine and *I. laevigata* lacks ornamentation on the exine but for the distal muri. *I. macula* differs in having 6-10 polygonal meshes on the distal side.

Dictyotriletes (Naum.) Pot. & Kr. 1954, 1955

Dictyotriletes invisus sp. nov.

Pl. 3, Figs. 59-60

Holotype — Pl. 3, Fig. 59.

Diagnosis — Subcircular miospores, 40-50 μ. Exine covered over by irregular muri forming meshes. Muri seen as low ridges on the *extrema lineamenta*.

Description — Light yellow miospores, holotype 50μ. Trilete mark hardly perceptible. Exine covered over by irregular muri which are not very much raised and on the *extrema lineamenta* appears to be up to 2 μ high, irregular in their distribution, occasionally forming meshes. In one of the specimens 8-9 meshes seen and on the equatorial margin about 20 ridges of the muri counted allowing a presumption that they are loosely arranged.

Comparison — The already known species of *Dictyotriletes* are from the Upper Carboniferous of Europe.

Spores referred to *Reticulatisporites* by Datta (1957, Figs. 79-80), are 43-50 μ in size and are thickly reticulate forming a large number of meshes. The specimens studied by us range in size from 40-50 μ and the reticulation is thin so much so that only 8-9 meshes are seen. Balme & Hennelly (1956b) do not report any comparable species from Australia.

Lycopodiumsporites Thierg. 1938

Lycopodiumsporites sp.

Pl. 3, Fig. 61

Description — Yellowish brown, circular, size 70-130μ, with a distinct Y-mark. Exine uniformly covered over by 6-10 μ high muri which form regular, polygonal meshes both on the proximal as well as the distal sides, enclosing broad lumina which are about 18 μ broad, muri appear as a thin narrow flange when running along the equator. The specimen illustrated here is not very nicely preserved still the lumina and the muri are clearly seen.

Turma — _Zonales_ (B. & K.) Pot. 1956
Subturma — _Zonotriletes_ Waltz 1935
Infraturma — _Zonati_ Pot. & Kr. 1954

Gondisporites Bharad. 1962

Gondisporites sp.

Pl. 3, Fig. 62

Description — Miospores circular, subcircular or roundly triangular in shape with a distinct inner body, 52-74 μ in size, rarely folded; overall size 92-140 μ; Y-mark prominent, with raised tecta, sometimes flexuose and ending at the ridge. Body exine uniformly covered over by ± 6 μ long verrucae varying in their size considerably. A gradual transition from small, ± 2 μ broad and equally long verrucae to ± 2 μ broad and ± 6 μ long coni like sculptural elements observed.

Comparison — *Gondisporites raniganjensis* Bharad., differs in possessing a baculogranulose ornamentation.

Turma — _Monoletes_ Ibr. 1933
Subturma — _Azonomonoletes_ Luber 1935
Infraturma — _Psilamonoleti_ V.D. Hamm 1955

Latosporites Pot. & Kr. 1954

Latosporites colliensis (B. & H.) Bharad. 1962

Pl. 3, Fig. 63

Description — The specimens studied by us, oval to circular in shape and varying from 44-96 μ in size. Monolete mark

prominent ranging from 28 to 75 μ in length, sometimes when open appearing like a fusiform slit. Generally monolete mark 1/2-2/3 the length of the spore, sometimes even more. Exine generally smooth with infrapunctate structure quite often noticed.

Comparison — Spore type 10 described by Virkki (1945; Pl. 3, Fig. 34) is 65-83 μ long, 45-60 μ broad, the monolete mark is 2/3 the length of the spore with tapering ends and thick wall. This specimen resembles in most of the characters to *L. colliensis*.

Latosporites sp.

Pl. 3, Fig. 64

Description — Miospores golden yellow in colour with oval to subcircular in shape, size ranging from 100-126 μ. Monolete mark up to 100 μ long with blunt ends. Exine infrapunctate, bearing ± 6 faint striations running mostly parallel to the mark.

Comparison — *Latosporites* sp., differs from *Latosporites colliensis* in possessing striations.

Infraturma — *Ornati* Pot. 1956

***Punctatosporites* Ibr. 1933**

Punctatosporites sp.

Pl. 3, Fig. 65

Description — Miospores yellowish brown, oval to circular, ± 24 μ. Monolete mark measuring up to 3/4 the length of the spore. Exine covered with ± 1 μ broad grana, *extrema lineamenta* coarse.

***Thymospora* Wills. & Venkatach. 1963**

Thymospora gondwanensis sp. nov.

Pl. 3, Figs. 66-69

Holotype — Bharad. 1962; Pl. 5, Fig. 80.

Diagnosis — Circular to oval miospores, 22-34 μ. Monolete mark going up to 3/4 the length of the spore. Exine covered with up to 2 μ broad verrucae.

Description — Yellowish brown, oval to circular, bean shaped in lateral view, rarely folded. Holotype 28 μ. Exine thickly set with verrucae, up to 2 μ broad at the base and usually sharp tipped, sometimes blunt tipped also, confluence of elements usually seen resulting in a pseudoreticulum; 25-35 verrucae clearly noticeable on the *extrema lineamenta*. In some cases verrucae longer than broad and look like blunt coni on the equatorial margin.

Comparison — *Thymospora leoparda* (Balme & Hennelly), comb. nov. is distinctly bigger. *T. pseudogranulata* (Bhard.) W. & V., though almost agreeing in size distinguishes in possessing smaller monolete mark and sparsely distributed verrucae and is described from the Upper Carboniferous of the Saar.

Anteturma — *Pollenites* Pot. 1931
Turma — *Saccites* Erdt. 1947
Subturma — *Monosaccites* (Chitaley) Pot. & Kr. 1954
Infraturma — *Triletesacciti* Lesch. 1955

***Nuskoisporites* Pot. & Kl. 1954**

Remarks — *Nuskoisporites*, as originally defined by Potonié and Klaus (1954), accommodates circular spores having a prominent, small, trilete-bearing body surrounded by a saccus with marginal limbus. Later, Balme and Hennelly (1956b) have included spores showing usually a thinner-walled body with a trilete mark absent or present with the rays small or extending to the margin of the body girdled by a thick and compressed (not blown up), non-limbate saccus in *Nuskoisporites*. Thus, morphographically these forms of Balme & Hennelly (1956b) do not agree with *N. dulhuntyi*, the genotype of *Nuskoisporites* in all respects. Likewise the specimens illustrated and described by Potonié & Lele (1960) tend to deviate from the original circumscription of the genus.

Specimens closely comparable to some of the forms of *Nuskoisporites* from Gondwana countries, have been illustrated and referred to *Latensina* Luber, by Alpern (1959). These also possess a thin-walled body with none or a hardly perceptible Y-mark seen only when open like a triangular opening, and a denser, presumably compressed (deflated) saccus. Other Lower Gondwana forms (*N. rotatus* Balme & Henn.) appear comparable to *Culleisporites* Leschik (1956) on the basis of what can be surmised out of the poor, solitary illustration of its diplotype and the still poorer generic diagnosis.

It is apparent that the taxonomic status and the systematics of the genus are far from finally settled. For this reason the assignment of our specimens to *Nuskoisporites* is only tentative.

Cf. *Nuskoisporites triangularis* (Mehta) Pot. & Lele 1960

Pl. 3, Fig. 70

Description — The specimens studied are yellowish brown in colour with a roundly triangular to subcircular outline. Size 130-134 μ. Spore body distinctly subcircular with a thin granulose exine and an easily distinguishable trilete mark. Saccus infrareticulate and narrow, ± 25 μ broad around the body.

Cf. *Nuskoisporites reticulatus* sp. nov.

Pl. 3, Figs. 71-72

Holotype — Pl. 3, Fig. 71.

Diagnosis — Subcircular, 106-162 μ. Y-mark seen when open; exine proximally irregularly, reticuloid striated; interstriated region finely intrareticulate. Saccus girdling the body, finely intrareticulate.

Description — Golden yellow, subcircular miospores; holotype 106 μ. Trilete mark distinct in holotype but indistinguishable in the second specimen, rays 2/3 the radius. Body exine intramicroreticulate, bearing reticuloid striations, meshes larger on proximal face but smaller on distal face. Saccus 16-24 μ broad, girdling the central body; saccus ornamented with small sized meshes measuring from 0·5 μ to 1.0 μ.

Comparison — Cf. *Nuskoisporites triangularis* has a distinct trilete mark with unequal rays, the body exine is granulose and the saccus is coarsely structured. *N. rotatus* has the body exine and the saccus finely intrareticulate as in Cf. *N. reticulatus*. However, the former possesses a distinct Y-mark whose rays almost reach the margin of the body and lacks the unmistakable reticuloid, striated body exine of Cf. *N. reticulatus*.

Infraturma — *Aletesacciti* Lesch. 1956

***Densipollenites* Bharad. 1962**

Densipollenites indicus Bharad. 1962

Pl. 4, Fig. 73

Remarks — Specimens observed by us are yellowish brown in colour and ± subcircular in shape. Overall size range recorded is 118-150 μ whereas the circular to subcircular body measuring 40-54 μ. Bladder generally folded in such a way that the pollengrains assume different shapes.

Densipollenites invisus sp. nov.

Pl. 4, Figs. 74-75

Holotype — Pl. 4, Fig. 74.

Diagnosis — Circular, 110-150 μ. Central body hardly distinguishable.

Description — Light yellowish brown, circular pollengrains. Holotype 150 μ. Central body wall presumably very thin, so hardly discernible. Bladder coarsely intrareticulate at the margin, but the meshes comparatively finer towards the centre.

Comparison — *Densipollenites indicus* differs from the present species in having a well-defined outline of the central body.

Densipollenites sp.

Pl. 4, Fig. 76

Description — Specimens studied light brown, circular, often folded to assume subcircular or other derived shapes, size ranging from 100-132 μ. Central body subcircular, 50-60 μ, thick and dense, covered over by the bladder on one side and appearing to be partially free on the other side; ornamentation of the body difficult to determine, however, in some specimens appearing to be microreticulate. Bladder coarsely intrareticulate and generally folded.

In the specimens illustrated here the folds in the bladder usually run across the central body confirming the presumption that the bladder is loose from the spore body on one side.

Comparison — *Densipollenites indicus* differs in having a thinner and translucent but well-defined central body and *D. invisus* in having ill-defined central body as compared to the denser body in *D.* sp. These specimens agree in their morphography with *Florinites eremus* Balme & Hennelly (1955, Pl. 5, Fig. 45).

Infraturma — *Striasacciti* Bharad. 1962

***Striomonosaccites* Bharad. 1962**

Striomonosaccites circularis sp. nov.

Pl. 4, Figs. 77-78

Holotype — Pl. 4, Fig. 77.

Diagnosis — Circular to subcircular, central body ± circular, distally a ± circular area free from the bladder, proximally 7-10 faint, horizontal striations; bladder 1/2-2/3 body diameter in width.

Description — Specimens circular to subcircular with a prominent ± circular body, in some of the specimens body outline appearing to be diffused (PL. 4, FIG. 78); size ranging from 92-150 μ. Proximal exine of the body possessing up to 10 generally forked striations; inbetween the striations exine intramicroreticulate. Bladder narrow, intrareticulate with medium to big sized meshes ranging in size from 2-4 μ.

Comparison — *Striomonosaccites ovatus* differs from the present species in being smaller in size, having narrower bladder and in bearing less number of striations on the body.

***Distriomonosaccites* Bharad. 1962**

Distriomonosaccites ovalis sp. nov.

Pl. 4, Figs. 79-80

Holotype — Pl. 4, Figs. 79-80.

Diagnosis — Subcircular, ± 85 × 110 μ. Central body subcircular with 5-6 striations on the proximal as well as on the distal side. Bladder up to 40 μ broad around the body.

Description — Golden yellow pollengrains with a darker central body. Holotype 85 × 110 μ. Central body subcircular, ± 30 × 40 μ, thick-walled, coarsely granulose with 5-6 striations on both the proximal and distal sides. Bladder intrareticulate with meshes of variable size.

Comparison — *Distriomonosaccites rotatus* differs in possessing a thin-walled, comparatively bigger body with more striations. The distinguishing feature of *D. ovalis* is a thick-walled body which is very small and bears only 5-6 striations.

Subturma — *Disaccites* Cookson 1947
Infraturma — *Podocarpoiditi* Pot., Thoms. & Theirg. 1950

***Platysaccus* (Naum.) Pot. & Kl. 1954**

Platysaccus sp.

Pl. 5, Fig. 81

Description — Yellowish brown with a dark central body, diploxylonoid, ± 86 μ. Body subcircular, ± 48 × 46 μ, microverrucose, thick-walled. Bladders hemispherical, attaching along the whole length but widely separated leaving a ± 10 μ wide area inbetween them, bladders intrareticulate with irregular meshes.

***Cuneatisporites* Leschik 1955**

Cuneatisporites sp.

Pl. 5, Fig. 82

Description — Yellowish with a brown central body. Size ± 110 μ. Central body vertically oval, ± 60 × 80 μ, margin diffused but uniformly thick all round, exine microverrucose without any true horizontal striations but a faint reticulation seen. Distally bladders show a full length attachment leaving a slightly biconvex, ± 24 × 16 μ wide bladder free area. Bladders mediumly intrareticulate.

Infraturma — *Striatiti* (Pant) Bharad. 1962
***Striatites* (Pant) Bharad. 1962**

Striatites notus sp. nov.

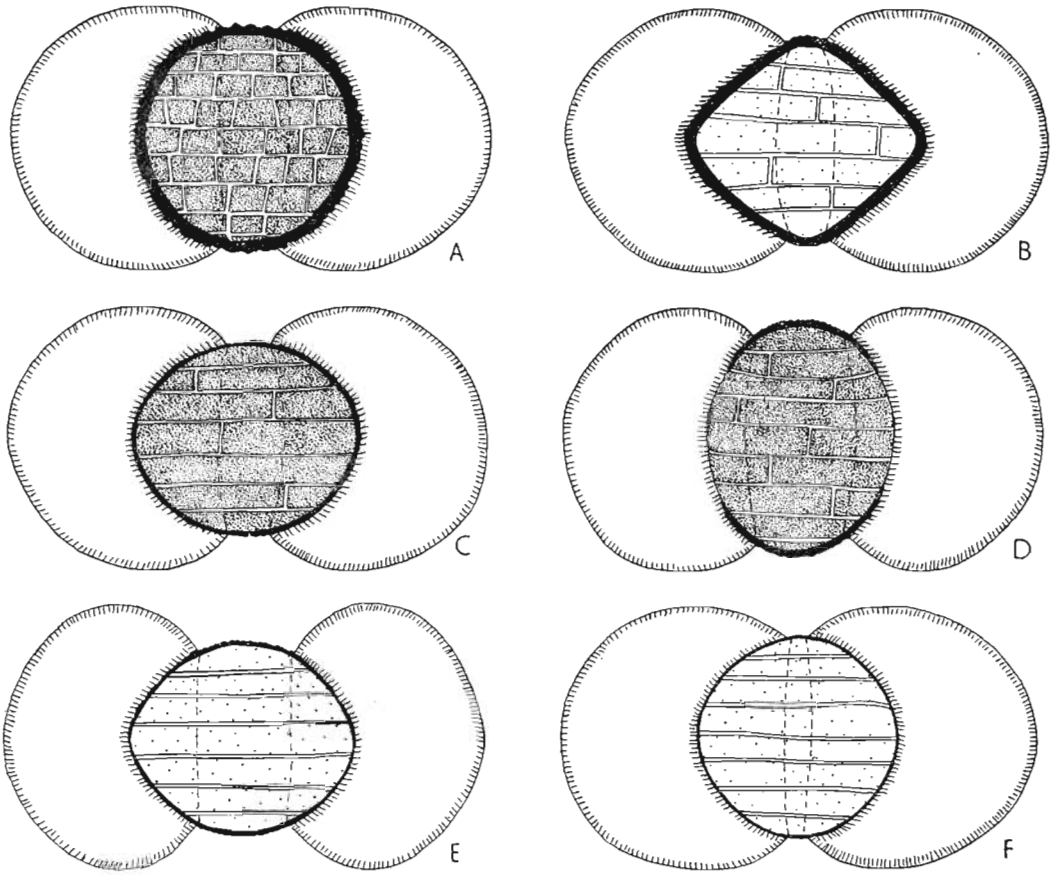
Pl. 5, Figs. 83-87

Holotype — Pl. 5, Fig. 83.

Diagnosis — Size 98-154 μ. Central body mostly dark brown, circular to subcircular, 36-48 μ × 36-52 μ, broad marginal ridge seen all round, horizontal striations 7-10 with many (16-32) vertical partitions inbetween. Bladder attachment convex, lateral distance between the bladders 3-11 μ.

Description — Pollengrains with a usually thick, circular to subcircular central body. Longer axis of the holotype 120 μ and central body 46 × 48 μ. Central body in all the specimens studied outlined by a distinct and broad marginal ridge; horizontal striations 7-10 with many (16-32) vertical partitions (TEXT-FIG. 4A); exine microverrucose with a characteristic, uneven pattern. Bladders subspherical, meeting distally in the middle of the body thereby leaving a convex, bladder-free area; laterally bladders 3-11 μ apart, with medium to big-sized intrareticulation. In one of the specimens a median crack present, running vertically over the body on the distal side.

Comparison — The description of the genotype *Striatites sewardi*, as given by Pant (1955) is very meagre thus a comparison with the present species is difficult. Bharadwaj (1962), after a detailed study of the genus emended the generic diagnosis according to which the specimens referred to the genotype are distinguished by a dark brown central body with a laterally prominent marginal ridge; proximally 7 horizontal striations with few vertical parti-



TEXT-FIG. 4 — Various species of *Striatites* showing detailed characters in each. (A) *S. notus*. (B) *S. rhombicus*. (C) *S. subtilis*. (D) *S. obtusus*. (E) *S. solitus* and (F) *S. communis*.

tions and a slightly convex bladder free area distally. The present species differs in having a circular to subcircular central body with a broad marginal ridge allround and many vertical partitions inbetween the horizontal striations.

Striatites rhombicus sp. nov.

Pl. 5, Figs. 88-90; Pl. 6, Fig. 91

Holotype — Pl. 5, Fig. 88.

Diagnosis — Size 56-136 μ. Central body mostly golden yellow, usually rhomboidal to subcircular or circular, 25-48 μ × 23-54 μ, marginal ridge distinct allround; horizontal striations 5-9 with few (2-7) vertical partitions. Bladder attachment convex, laterally bladders 3-11 μ apart.

Description — Pollengrains with a thin, usually rhomboidal to subcircular or circular central body. Horizontal axis of the holotype 121 μ and central body 48 × 54 μ. Body in all the specimens studied lined on the outside by a distinct, allround prominent marginal ridge (TEXT-FIG. 4B), proximally bearing 5-9 horizontal striations with few (2-7) intersecting vertical partitions; exine microverrucose. Bladders subcircular, with medium-to big-sized intrareticulations; distally sulcus convex, laterally bladders 3-11 μ apart.

Comparison — *Striatites notus* has a thick, circular to subcircular central body with many vertical partitions inbetween the horizontal striations. The present species distinguishes in having a thin, usually rhomboidal to circular central body with

few vertical partitions intersecting the horizontal striations.

Striatites subtilis sp. nov.

Pl. 6, Figs. 92-97

Holotype — Pl. 6, Fig. 92.

Diagnosis — Size 63-128 μ. Central body mostly dark brown, circular to subcircular, 25-52 μ × 30-50 μ, marginal ridge thin. Horizontal striations 5-9 with few (2-8) vertical partitions inbetween. Bladder attachment convex, bladders with small- to medium-sized meshwork, laterally bladders 3-11 μ apart.

Description — Pollengrains with a usually thick, circular to subcircular central body. Horizontal axis of the holotype 114 μ and central body 40 × 44 μ. Usually thin, uniformly broad, marginal ridge present around the body, sometimes marginal ridge seen more prominently only on the lateral sides of the body; body exine microverrucose, proximally bearing 5-9 horizontal striations with few (2-8) vertical partitions (TEXT-FIG. 4C). Bladders subcircular with small- to medium-sized intrareticulation, meeting along the whole length distally and leaving a slightly convex area free from the bladders; laterally bladders 3-11 μ apart.

Comparison — *Striatites notus* differs in having many vertical partitions inbetween the horizontal striations and medium- to big-sized intrareticulation of the bladders. *S. rhombicus* differs in having a thin, usually rhomboidal to circular central body, few vertical partitions inbetween the horizontal striations and medium- to big-sized meshwork of the bladders. The present species distinguishes in having a thick, circular to subcircular central body with a thin marginal ridge, few vertical partitions inbetween the horizontal striations and small- to medium-sized intrareticulation of the bladders.

Striatites obtusus sp. nov.

Pl. 6, Figs. 98-100

Holotype — Pl. 6, Fig. 98.

Diagnosis — Size 86-138 μ. Central body dark brown, vertically oval to subcircular, 36-62 μ × 33-75 μ, thin marginal ridge seen laterally. Horizontal striations 6-10 with few (3-9) vertical partitions. Distally bladder attachment full length, sulcus convex; laterally bladders 10-19 μ apart.

Description — Pollengrains bisaccate with a usually thick, vertically oval to subcircular central body. Horizontal axis of the holotype 122 μ, body measuring 52 × 48 μ. Marginal ridge thin, seen only laterally; body exine microverrucose, bearing 6-10 horizontal striations on its proximal face; vertical partitions inbetween the horizontal striations few (3-9) (TEXT-FIG. 4D). Bladders subcircular with medium-sized intrareticulation, meeting distally in the middle of the body thereby leaving a convex bladder-free area; lateral distance between the bladders 10-19 μ.

Comparison — *Striatites notus* differs in having a dark brown central body with a broad marginal ridge allround, many vertical partitions inbetween the horizontal striations and laterally the bladders only 3-11 μ apart. *S. rhombicus* differs in having golden yellow, thin, usually rhomboidal to circular central body with an allround prominent marginal ridge and only a 3-11 μ broad distance between the bladders laterally. *S. subtilis* stands apart in having a thick, circular to subcircular central body, few vertical partitions inbetween the horizontal striations, small- to medium-sized intrareticulation of the bladders and narrow sulcus. *S. obtusus* distinguishes itself by having a thick, vertically oval to subcircular central body with a laterally seen marginal ridge, few vertical partitions inbetween the horizontal striations and the strikingly wide (10-19 μ) gap between the bladders.

Striatites solitus sp. nov.

Pl. 6, Figs. 101-103; Pl. 7, Fig. 104

Holotype — Pl. 6, Fig. 101.

Diagnosis — Size 70-112 μ. Central body golden yellow, subcircular 34-50 μ × 36-50 μ with a laterally more prominent marginal ridge. Horizontal striations 5-9 without any vertical partitions. Distally bladder attachment full length; straight to slightly convex bladder-free area; laterally bladders 12-17 μ apart.

Description — Pollengrains bisaccate and bilateral. Horizontal axis of the holotype 102 μ and the central body 42 × 40 μ. Central body thin, golden yellow in colour, subcircular, marginal ridge more prominent laterally; horizontal striations 5-9 on the proximal face of the body; vertical intersecting partitions absent (TEXT-FIG. 4E),

exine microverrucose. Distal bladder-free area straight to slightly convex; laterally bladders 12-17 μ apart. Bladders subspherical with almost a medium-sized meshwork.

Comparison — *Striatites notus* has a thick central body with an allround prominent marginal ridge and many vertical partitions inbetween the horizontal striations. *S. subtilis* and *S. obtusus* have a dark brown central body, have few verticals intersecting the horizontal striations and the former with a narrower distance between the bladders laterally. *S. rhombicus* also differs in having narrower lateral distance between the bladders. The present species distinguishes in having a thin central body with a broad, laterally prominent marginal ridge, no vertical partitions inbetween the horizontal striations and a very wide lateral gap between the bladders.

Striatites communis sp. nov.

Pl. 7, Figs. 105-107

Holotype — Pl. 7, Fig. 105.

Diagnosis — Size 75-134 μ. Central body golden yellow, circular to subcircular, 40-52 μ × 42-56 μ without any distinct marginal ridge. Horizontal striations 7-9 and without any vertical partitions as far as observed. Distally bladder free area narrowly biconvex, bladders coming together on lateral sides.

Description — Pollengrains bisaccate and bilateral. Horizontal axis of the holotype 120 μ and the body 52 × 56 μ. Central body in all the specimens studied thin, circular to subcircular without any trace of marginal ridge around it (TEXT-FIG. 4F). Horizontal striations on the proximal face of the body 7-9, vertical partitions not seen; exine microverrucose. Bladder attachment full length; sulcus biconvex with the bladders comparatively closer on the lateral sides in relation to the middle region; bladders subcircular with a small- to medium-sized intrareticulation. In some of the specimens studied a median crack present running vertically over the body.

Comparison — *Striatites notus*, *S. subtilis* and *S. obtusus* have a dark brown central body and also with vertical partitions inbetween the horizontal striations. *S. solitus*, though agreeing with the present species in lacking vertical partitions, differs in having the bladders very widely separated laterally. The present species distinguishes in

TABLE 1 — DELIMITED SPECIES OF *STRIATITES*

NAME OF THE SPECIES	OVERALL SIZE IN μ	SHAPE, SIZE & COLOUR OF C. BODY	BODY SIZE STATISTICAL MEAN	MARGINAL RIDGE	HORIZONTAL STRIATIONS	VERTICAL PARTITIONS	SHAPE & LAT. SULCUS WIDTH	BLADDER INTRARETICULATION
Striatites notus	98-154	Circular to subcircular, 36-48 × 36-52μ, D. brown	41·5 × 47·4μ	Broad & allround	7-10	16-32	Convex, 3-11μ	Medium to big
S. rhombicus	56-136	Rhomboidal to subcircular to circular, 25-48 × 23·54μ, G. yellow	41·5 × 47·4μ	Distinct & allround	5-9	2-7	Convex, 3-11μ	Medium to big
S. subtilis	63-128	Circular to subcircular, 25-52 × 30-50μ, D. brown	41·5 × 36·3μ	Thin	5-9	2-8	Convex, 3-11μ	Small to medium
S. obtusus	86-138	Vert. oval to subcircular, 36-62 × 33-75μ, D. brown	54·8 × 47·4μ	Thin & laterally seen	6-10	3-9	Convex, 10-19μ	Medium
S. solitus	70-112	Subcircular, 34-50 × 36·50μ, G. yellow	41·5 × 47·4μ	Seen laterally	5-9	—	Straight to slightly convex, 12-17μ	Medium
S. communis	75-134	Circular to subcircular, 40-52 × 42-56μ, G. yellow	41·5 × 47·4μ	Indistinct	7-9	—	Narrow and convex, 2-4μ	Small to medium

having a thin, ill-defined central body without any marginal ridge around it; the horizontal striations lacking the vertical partitions inbetween them and laterally the bladders coming close together.

Verticipollenites Bharad. 1962

Verticipollenites crassus sp. nov.

Pl. 7, Figs. 108-109

Holotype — Pl. 7, Figs. 108-109.

Diagnosis — Size ± 138 μ. Central body dark brown, ± circular with a broad marginal ridge; ± 9 horizontal striations with many vertical partitions (± 21) inbetween; exine microverrucose; bladder attachment partial, distally zones of bladder attachment ± 9 μ apart.

Description — Pollengrains usually with a thick, dark brown, ± circular central body. Longer axis of the holotype 138 μ, body measuring 54 × 52 μ. Central body lined allround by a distinct 4-6 μ broad marginal ridge; proximally bearing ± 9 horizontal striations with many (± 21) vertical partitions inbetween (TEXT-FIG. 5A). Distally bladder attachment partial with a sulcus ± 9 μ broad at the distal pole. Bladders almost subspherical with almost big-sized intrareticulation. A median crack running vertically over the whole of the body present.

Comparison — *Verticipollenites secretus*, the genotype, described by Bharadwaj (1962) has a circular to horizontally oval central body with a distal furrow like bladder-free area. *V. oblongus* Bharad., differs in having a vertically oval central body and a medium sized bladder intrareticulation. The present species distinguishes in having a circular central body with a distinct, marginal ridge allround and a coarser meshwork of the bladders.

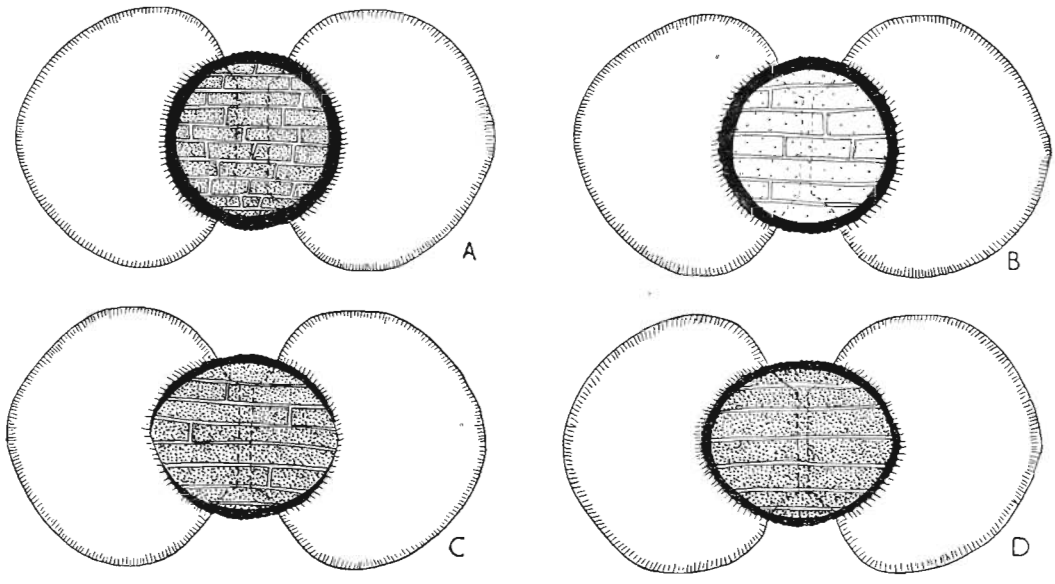
Verticipollenites finitimus sp. nov.

Pl. 7, Figs. 110-114

Holotype — Pl. 7, Fig. 110.

Diagnosis — Size 62-120 μ. Central body golden-yellow, circular to subcircular, 30-50 μ × 35-48 μ with a distinct marginal ridge allround; horizontal striations 5-9 with few (3-7) vertical partitions; exine microverrucose. Zones of bladder attachment at the distal pole 1·5-4 μ apart.

Description — Pollengrains bisaccate and bilateral. Horizontal axis of the holotype 98 μ and the body measuring 43 × 39 μ. Central body in all the specimens observed thin, circular to subcircular; exine micro-



TEXT-FIG. 5 — Various species of *Verticipollenites* showing detailed characters in each. (A) *V. crassus*. (B) *V. finitimus*. (C) *V. subcircularis* and (D) *V. gibbosus*.

verrucose, proximally bearing 5-9 horizontal striations with few (3-7) vertical partitions inbetween them (TEXT-FIG. 5B). Bladders subspherical, pitcher-shaped with medium- to big-sized intrareticulation; distally bladders coming close to each other in the middle of the central body.

Comparison — *Verticipollenites secretus*, *V. oblongus* and *V. crassus* have a thick central body and many vertical partitions inbetween the horizontal striations. *V. gibbosus* has a thick, horizontally oval central body without any vertical connectives inbetween the horizontal striations and the bladder intrareticulation is fine. The present species distinguishes in having a thin central body, the vertical partitions inbetween the horizontal striations are few and the bladder intrareticulation is medium- to big-sized.

Verticipollenites subcircularis sp. nov.

Pl. 8, Figs. 115-117.

Holotype — Pl. 8, Fig. 115.

Diagnosis — Size 95-125 μ. Central body mostly brown, circular to subcircular, 40-58 μ × 40-55 μ, with laterally more prominent marginal ridge; 6-9 horizontal striations with few (2-4) vertical partitions.

Description — Pollengrains usually with a thick, brown central body. Horizontal axis of the holotype 108 μ and the central body 56 × 53 μ. Central body in all the specimens studied, thick, circular to subcircular with a marginal ridge, prominently seen laterally (TEXT-FIG. 5C); proximally bearing 6-9 horizontal striations; vertical partitions inbetween the horizontal striations few (2-4); exine microverrucose. Distally bladder attachment partial. Bladders subcircular with almost medium-sized meshwork. In one of the specimens studied, distally a median crack present.

Comparison — *Verticipollenites secretus*, *V. oblongus* and *V. crassus* differ in having an allround prominent marginal ridge around the body, and many vertical partitions inbetween the horizontal striations. *V. gibbosus* differs in having a horizontally oval central body and a fine bladder intrareticulation. *V. finitimus* differs in having a thin central body with the marginal ridge seen allround.

Verticipollenites gibbosus Bharad. 1962

Pl. 8, Fig. 118

Remarks — Pollengrains studied here by us are bisaccate, bilateral with a usually dark brown central body. The horizontal axis of the specimens observed ranges from 84-98 μ, holotype being 96 μ. Central body thick, horizontally oval (40-45 μ × 34-37 μ) with a distinct marginal ridge seen allround; exine microverrucose, proximally bearing 5-8 horizontal striations without any vertical partitions (TEXT-FIG. 5D). Bladders subspherical with small- to medium-sized meshwork.

***Lahirites* Bharad. 1962**

Remarks — The body exine structure in the genus *Lahirites* is intrapunctate (Bharad. 1962). From a detailed study of a large number of specimens here it has been observed that the punctations can be of a fine or coarse nature. A variation in their arrangement is also observed i.e. the punctations may be spread uniformly over the whole exine or be localized in rows in the interstriated regions (TEXT-FIG. 2). For these the terms *uniform* or *restricted* have been used in the descriptions.

Lahirites singularis sp. nov.

Pl. 8, Figs. 119-121

Holotype — Pl. 8, Fig. 119.

Diagnosis — Size 86-128 μ. Central body golden yellow, rhomboidal to subcircular, 38-54 μ × 40-62 μ with a distinct marginal ridge allround; horizontal striations 5-9 with few (2-7) vertical partitions; exine finely, uniformly intrapunctate. Laterally bladders 5-9 μ apart; attachment full length.

Description — Pollengrains bisaccate, bilateral. Horizontal axis of the holotype 110 μ and the body 44 × 46 μ. All the specimens studied for this species have a thin, rhomboidal to subcircular central body with a distinct marginal ridge allround (TEXT-FIG. 6A); horizontal striations on the proximal face of the body 5-9 with few (2-7) vertical partitions inbetween; exine intrapunctate, puncta fine and uniformly distributed over the whole exine. Bladders almost subspherical, with medium- to big-sized intrareticulation; sulcus straight to slightly convex; laterally bladders 5-9 μ apart.

TABLE 2 — DELIMITED SPECIES OF *VERTICIPOLLENITES*

Name of the species	Overall size in μ	Shape, size & colour of C. body	Body size statistical Mean	Marginal ridge	Horizontal striations	Vertical partitions	Bladder intrareticulation
Verticipollenites crassus	±138	± Circular, ± 54 × 52μ, D. brown	51·5×48·4μ	Broad & allround	±9	±21	Big.
V. finitimus	62-120	Circular to subcircular, 30-50×35-48μ, G. yellow	40·5×38·3μ	Distinct	5-9	3-7	Medium to big
V. subcircularis	95-125	Circular to subcircular, 40-58×40-55μ, Brown	51·5×48·4μ	Laterally prominent	6-9	2-4	Medium
V. gibbosus	84-98	Horizontally oval, 40-45×34-39μ, D. brown	40·5×38·3μ	Seen allround	5-8	—	Small to medium

Comparison — Lahirites raniganjensis Bharad., differs by having an indistinct marginal ridge, restrictedly intrapunctate structure and many vertical connectives inbetween the horizontal striations. The present species distinguishes in having a thin, rhomboidal to subcircular central body with a distinct marginal ridge all-round, few vertical partitions inbetween the horizontal striations and uniformly intrapunctate structure of the body exine.

Lahirites incertus sp. nov.

Pl. 8, Figs. 122-124

Holotype — Pl. 8, Fig. 122.

Diagnosis — Size 88-142 μ. Central body golden yellow, subcircular 42-62 μ × 44-56 μ, marginal ridge usually prominent but narrow; horizontal striations 7-10 with few (3-7) vertical partitions; exine uniformly intrapunctate. Bladder attachment full length; laterally bladders 10-18 μ apart.

Description — Pollengrains bisaccate and bilateral. Horizontal axis of the holotype 114 μ and the body measuring 48 × 56 μ. Central body thin in all the specimens studied and subcircular with a ± 2 μ wide marginal ridge. Exine intrapunctate, puncta uniformly distributed over the whole exine; proximally bearing 7-10 horizontal striations with few (3-7) vertical partitions inbetween (Text-fig. 6B). Bladders almost subcircular with medium- to big-sized intrareticulation; sulcus straight to slightly convex; laterally bladders 10-18 μ apart.

Comparison — Lahirites raniganjensis has a thick, circular central body with an indistinct marginal ridge and restricted intrapunctation of the exine. *L. singularis* has broad marginal ridge and the lateral distance between the bladders is 6-9 μ. *L. incertus* distinguishes in having a thin central body, a narrower but sharply defined marginal ridge and the distance between the bladders at the lateral poles is 10-18 μ.

Lahirites rotundus sp. nov.

Pl. 8, Fig. 125; Pl. 9, Figs. 126-127

Holotype — Pl. 8, Fig. 125.

Diagnosis — Size 109-134 μ. Central body brown, circular to subcircular, 42-58 μ × 36-48 μ with a laterally prominent marginal ridge; horizontal striations 7-9 with few (2-5) vertical partitions; exine restrictedly

intrapunctate. Bladder attachment full length; laterally bladders 13-19 μ apart.

Description — Pollengrains usually with a dark brown central body. Longer axis of the holotype 109 μ and the body 42 × 42 μ. Central body thick in all the specimens studied and circular to subcircular with laterally prominent marginal ridge; proximally 7-9 horizontal striations with few (2-5) vertical partitions inbetween (TEXT-FIG. 6C); exine restrictedly intrapunctate, i.e. puncta arranged inbetween and parallel to the striations leaving a ± 1 μ wide space on either side. Bladders subspherical with medium-sized meshwork, widely separated; lateral distance between the bladders 13-19 μ.

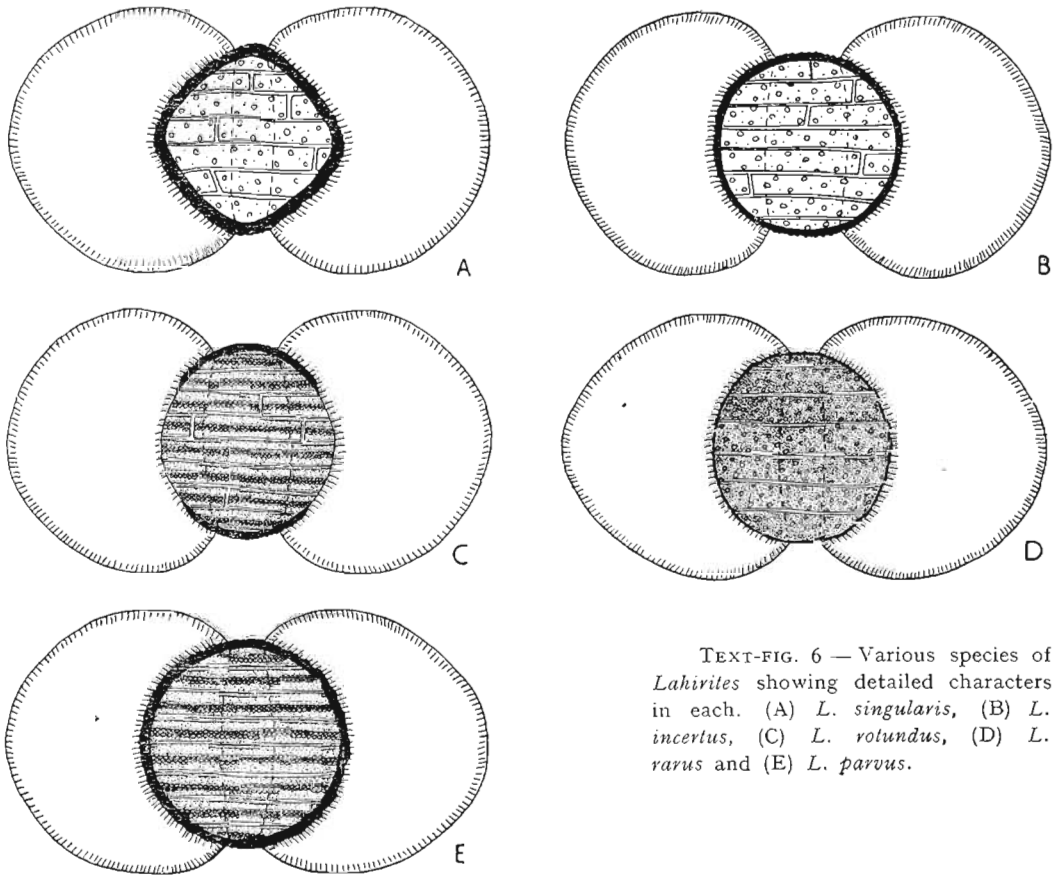
Comparison — The present species differs from the other species described here, i.e. *L. singularis* and *L. incertus* in having a thick central body with restrictedly intrapunctate structure and very widely separated bladders at the lateral sides. *L. raniganjensis* differs in having a central body with an indistinct marginal ridge and many vertical partitions inbetween the horizontal striations.

Lahirites rarus sp. nov.

Pl. 9, Figs. 128-130

Holotype — Pl. 9, Fig. 128.

Diagnosis — Size 82-102 μ. Central body mostly dark brown, subcircular to oval, 38-46 μ × 36-48 μ, exine finely, uniformly intrapunctate; horizontal striations 5-8 without any vertical partitions. Bladders with medium-sized meshwork, attachment full length, laterally 8-14 μ apart.



TEXT-FIG. 6 — Various species of *Lahirites* showing detailed characters in each. (A) *L. singularis*, (B) *L. incertus*, (C) *L. rotundus*, (D) *L. rarus* and (E) *L. parvus*.

Description — Pollengrains usually with a dark brown central body. Horizontal axis of the holotype 95 μ and the body 40 × 43 μ. Central body in all the specimens thick and subcircular to oval; horizontal striations on the proximal face of the body 5-8 without any vertical partitions inbetween them; exine finely and uniformly intrapunctate (TEXT-FIG. 6D). Bladders almost subcircular with medium-sized intrareticulation; sulcus straight to slightly convex, laterally bladders 8-14 μ apart.

Comparison — *Lahirites raniganjensis*, the genotype differs in having a circular central body, ± 9 horizontal striations with many vertical partitions inbetween them. *L. singularis* and *L. incertus* differ in possessing a golden yellow central body. *L. rotundus* has restrictedly intrapunctate structure in the body exine.

Lahirites parvus sp. nov.

Pl. 9, Figs. 131-132

Holotype — Pl. 9, Fig. 131.

Diagnosis — Size 88-138 μ. Central body brown, circular to subcircular, 40-50 μ × 42-52 μ with a distinct marginal ridge allround; horizontal striations 5-8 without any vertical partitions; exine restrictedly, coarsely intrapunctate; bladder attachment full length, laterally bladders 7-10 μ apart.

Description — Pollengrains with a usually brown central body. Horizontal axis of the holotype 100 μ and the body 40 × 42 μ. Central body thick, circular to subcircular with a distinct marginal ridge allround; body proximally bearing 5-8 horizontal striations without any vertical connectives (TEXT-FIG. 6E); exine restrictedly and coarsely intrapunctate i.e. puncta big and irregular, arranged in the middle region between the horizontal striations. Bladders almost subspherical, with medium- to big-sized intrareticulation, sulcus slightly convex; laterally bladders 7-10 μ apart.

Comparison — *Lahirites raniganjensis*, though resembling the present species in having a brown, circular central body with its restricted exine structure differs in having a distinct body marginal ridge and many vertical partitions inbetween the horizontal striations. *L. singularis*, *L. incertus* and *L. rarus* have uniformly intrapunctate body exine. *L. rotundus* has the widest, lateral bladder-free area. The

TABLE 3 — DELIMITED SPECIES OF *LAHIRITES*

NAME OF THE SPECIES	OVERALL SIZE IN μ	SHAPE, SIZE & COLOUR OF C. BODY	BODY SIZE STATISTICAL MEAN	MARGINAL RIDGE	ARRANGEMENT OF PUNCTA	HORIZONTAL STRIATIONS	VERTICAL PARTITIONS	SHAPE & LAT. SULCUS WIDTH	BLADDER INTRARETICULATION
Lahirites singularis	86-128	Rhomboidal to subcircular, 38-54 × 40-62μ, G. yellow	43·2×56·7μ	Distinct	Finely & uniformly	5-9	2-7	Straight to sli. convex, 5-9μ	Medium to big
L. incertus	88-142	Subcircular, 42-62 × 44-56μ, G. yellow	53·2×44·9μ	Prominent but narrow	Uniformly	7-10	3-7	Straight to sli. convex, 10-18μ	Medium to big
L. rotundus	109-134	Circular to subcircular, 42-58×36-48μ, Brown	53·2×44·9μ	Laterally prominent	Restrictedly	7-9	2-5	Straight to sli. convex. 13-21μ	Medium
L. rarus	82-102	Subcircular to oval, 38-46×36-48μ, D. brown	43·2×44·9μ	Thin & allround	Finely & uniformly	5-8	—	Straight to sli. convex, 8-14μ	Medium
L. parvus	88-138	Circular to subcircular, 40-50×42-52μ, Brown	43·2×44·9μ	Distinct allround	Restrictedly & coarsely	5-8	—	Slightly convex, 7-10μ	Medium to big

present species distinguishes in possessing restrictedly, coarsely intrapunctate exine, without any vertical partitions and with a narrower gap between the bladders laterally.

Lahirites sp.

Pl. 9, Fig. 133

Description — Pollengrains bisaccate, with a dark brown central body. Horizontal axis ± 86 μ and the body ± 42 × 42 μ. Central body thick, circular, proximally bearing ± 7 horizontal striations with few (± 3) vertical partitions inbetween them; exine restrictedly intrapunctate i.e. punctations seen in rows parallel to and inbetween the horizontal striations. Bladders almost subspherical with a very small-sized intrareticulation, meeting distally in the middle of the body thereby leaving a thin, convex bladder-free area; laterally bladders ± 2 μ apart.

Comparison — The present specimen distinguishes in having a thick central body with restrictedly intrapunctate exine and chiefly the very fine intrareticulation of the bladders.

Remarks — So far only one specimen has been recovered from the whole assemblage. In its characters it stands sufficiently apart from all the other species described earlier, the most important character in this case is of bladder intrareticulation which is the finest so far recorded.

Hindipollenites Bharad. 1962

Hindipollenites indicus Bharad. 1962

Pl. 9, Fig. 134

Remarks — The specimens studied here are bisaccate, bilateral. The horizontal axis of the pollengrains ranges from 104-120 μ, holotype being 120 μ. The central body is mostly light brown, vertically oval with a faint, wavy outline; marginal ridge indistinct; exine restrictedly and coarsely intrapunctate i.e. puncta big and irregular, arranged in the middle region inbetween the horizontal striations; horizontal striations 7-10 with few (3-8) vertical, connecting striations inbetween. Bladders are subspherical with small- to medium-sized meshwork; attachment partial, sulcus narrow in the middle and broader laterally

Hindipollenites oblongus sp. nov.

Pl. 9, Figs. 135-136

Holotype — Pl. 9, Fig. 135.

Diagnosis — Size 100-132 μ. Central body dark brown, subcircular 44-58 μ × 39-54 μ, horizontal striations 5-7 with many (16-30) vertical connectives; exine restrictedly, coarsely intrapunctate; distally zones of bladder attachment 1·5-2·5 μ apart.

Description — Pollengrains bisaccate with a dark brown central body. Longer axis of the holotype 132 μ and the body 58 × 54 μ. Central body thick, subcircular; exine restrictedly and coarsely intrapunctate, i.e. big and irregular puncta arranged in the middle region between the striations; horizontal striations 5-7 with many (16-30) vertical partitions. Distal sulcus narrow (1·5-2·5 μ) in the middle and broader (6-8 μ) laterally. Bladders subspherical with medium- to big-sized intrareticulation.

Comparison — *Hindipollenites indicus*, the genotype has 7-10 horizontal striations with few vertical partitions on the body. The present species distinguishes in having many vertical partitions inbetween the horizontal striations.

Lunatisporites Leschik 1955

Lunatisporites fuscus Bharad. 1962

Pl. 9, Fig. 137

Remarks — The specimens observed here are bisaccate, bilateral and yellowish brown in colour, the longer axis measuring 110-130 μ. Central body is vertically oval with a very clearly demarcated outline, pointed at the lateral ends and measuring 56-68 μ. Exine is intramicroreticulate, proximally bearing 5-7 mostly simple, horizontal striations. Bladders are attached distally to the central body leaving a 15-20 μ wide, biconvex and thin, bladder-free area. Bladders are nearly subcircular in shape with medium-sized meshwork.

Lunatisporites sp. A

Pl. 10, Fig. 138

Description — A study of the specimens of *Lunatisporites* sp. A, shows that they are bilateral, golden yellow in colour. Horizontal axis measures from 102-130 μ. Central body vertically oval with a distinct

outline, usually 2-3 μ thick. Body exine intramicroreticulate bearing 8-10 horizontal striations on its proximal face. In most of the specimens both simple as well as forked striations present and only in few specimens simple striations alone are met with. Bladders attaching laterally and distally to the body leaving a distinct 10-16 μ wide sulcus, broad in the centre and tapering towards the poles. Each sulcus edge marked by a fold accompanying its whole length. Bladders subspherical and intrareticulate with medium- to big-sized (1·5-4 μ) meshes.

Comparison — *Lunatisporites fuscus*, the genotype, has a broadly oval to subcircular body with only 5-7 horizontal striations and ledge-like extensions of the bladders on the lateral sides. *L.* sp. A, distinguishes in having an elliptical body bearing more striations and absence of lateral bladder ledges.

Lunatisporites s p. B

Pl. 10, Fig. 139

Description — The specimens of *Lunatisporites* sp. B, yellowish brown in colour, bisaccate and bilateral. The overall size of the horizontal axis ranging from 112-140 μ. Central body oval, broad in the centre and converging at the poles. Exine ornamentation intramicroreticulate. Horizontal striations 8-11 on the proximal face of the body. The incidence of the specimens bearing only simple striations and the ones bearing both simple as well as forked striations is almost equal. Bladders laterally and distally attached leaving a 14-22 μ wide (in the centre) thin area, being broad at one end and tapering on the other thus appearing like a boat. Bladders almost subspherical, intrareticulate with incomplete, medium- to big-sized meshes, ranging from 1-4 μ.

Comparison — *Lunatisporites fuscus* and *L.* sp. A, have a narrow, vertically biconvex sulcus. *L.* sp. B, distinguishes from the above species in possessing a boat shaped sulcus which is narrow at one end and broader on the other.

Striatopodocarpites **(Soritsch. & Sed. 1954) Bharad. 1962**

Striatopodocarpites decorus sp. nov.

Pl. 10, Figs. 140-142 & 146

Holotype — Pl. 10, Fig. 140.

Diagnosis — Size 100-120 μ. Central body rhomboidal with truncate ends, bearing 6-8 striations proximally, distally a sulcus uniformly up to 20 μ wide present.

Description — Yellowish brown, bilateral pollengrains. Holotype 104 μ. Central body rhomboidal with truncate ends, exine intramicroreticulate. Distally bladders forming a distinct sulcus uniformly up to 20 μ wide with straight edges. Bladders intrareticulate with meshes of mostly medium-size.

Comparison — *Striatopodocarpites antiquus*, the genotype differs in having a ± circular, thick and equatorially folded central body and coarse intrareticulation of the bladders. The present species distinguishes in having a well-defined, rhomboidal central body with truncate ends and a uniformly broad saccus-free area.

Striatopodocarpites magnificus sp. nov.

Pl. 10, Figs. 143-145 & 147

Holotype — Pl. 10, Fig. 143.

Diagnosis — Size 130-160 μ. Central body circular to subcircular, 70-90 μ, exine with 8-10 proximal horizontal striations. Distally a broad sulcus present.

Description — Yellowish brown, holotype measuring 154 μ. Central body circular to subcircular, vertically as high as the individual bladder or slightly more; proximally 8-10 simple striations present; exine intramicroreticulate; on the distal side a ± 25 μ wide channel present, often with a median fold or suture. Bladders intrareticulate with medium- to big-sized meshes.

Comparison — *Striatopodocarpites decorus* is smaller in size and has a rhomboidal central body. The present species distinguishes in being bigger in size and in possessing a circular to subcircular central body which is almost as big as the individual bladder.

Striatopodocarpites diffusus sp. nov.

Pl. 11, Figs. 148-149

Holotype — Pl. 11, Fig. 148.

Diagnosis — 120-160 μ. Central body ± hexagonal with slightly rounded angles, uniformly dense, bearing 8-11 horizontal striations. Bladders widely separated leaving a ± 20 μ wide sulcus.

Description — Yellowish brown pollen grains with a dark brown central body. Holotype 134 μ. Body hexagonal with a ± diffused, dense outline, exine intramicroreticulate, proximally bearing 8-11 horizontal striations which are usually simple but sometimes forked. Bladders hemispherical with medium- to big-sized intrareticulation, attached distally leaving a uniformly ± 20 μ wide bladder-free area on the body.

Comparison — The present species distinguishes in possessing a hexagonal, dark brown central body with diffused margin; proximally bearing 8-11 striations and a uniformly broad bladder-free area on the distal face.

Faunipollenites Bharad. 1962

Faunipollenites varius Bharad. 1962

Pl. 11, Fig. 150

Remarks — The specimens of *Faunipollenites varius* observed here are golden yellow, bilateral and haploxylonoid pollen-grains. The horizontal and vertical axes range in size from 88-136 μ × 65-77 μ, the holotype measuring 106 μ. The central body has an illdefined outline, its limits being made out by the ends of the striations. Exine is intramicroreticulate with 6-8 horizontal striations on its proximal face. Usually only simple striations are present and specimens with both simple as well as forked striations are comparatively less frequent. The distal bladder attachment forms an illdefined up to 30 μ wide sulcus which is seen as a thin area. Bladders are hemispherical, intrareticulate with medium- to big-sized meshes ranging from 1-4 μ in diameter.

Faunipollenites sp. A.

Pl. 11, Fig. 151

Description — Golden yellow, roundly bilateral and haploxylonoid. Horizontal axis 100-148 μ, but most of the specimens come in the size range 100-120 μ. Vertical axis 88-110 μ. Central body almost subcircular, faintly discernible, proximally bearing 9-12 horizontal striations, usually simple as well as forked in the same specimen; specimens with only simple striations comparatively less frequent. Exine intramicroreticulate; distally a 20-30 μ wide bladder free area with thin exine present. Bladders hemispherical,

TABLE 4 — DELIMITED SPECIES OF *STRIATOPODOCARPITES*

Name of the species	Overall size in μ	Shape, size & colour of the C. body	Body outline	Horizontal striations	Shape & width of the sulcus	Bladder intrareticulation
Striatopodocarpites decorus	100-120	Rhomboidal, 54-68μ, G. yellow	Well defined	6-8	Uniform, 12-20μ	Medium
S. magnificus	130-160	Circular to subcircular, 70-90μ, G. yellow	Well defined	8-10	Uniform, 22-28μ	Medium to big
S. diffusus	120-160	Hexagonal, 65-80μ, Brown	Diffused	8-11	Uniform, 18-22μ	Medium to big

intrareticulate with medium to big-sized meshes ranging from 1-4 μ in diameter.

Comparison — *Faunipollenites varius* is longish bilateral in shape, smaller in size with the body bearing fewer striations on the proximal face and wider sulcus in proportion to the overall size.

Faunipollenites sp. B.

Pl. 11, Fig. 152

Description — Golden yellow with a brown central body whose limits are not well-defined. Size 100-130 μ. Body broadly oval, with 6-7 striations on the proximal face. Distally a ± 20 μ wide, ill-defined, biconvex sulcus present; body exine intramicroreticulate. Bladders hemispherical, widely apart.

Comparison — The present species differs from all the other species described earlier by having a brown, broadly oval central body with a distal, biconvex, saccus-free area.

Infraturma — *Rectistriati* Bharad. 1962

***Striapollenites* Bharad. 1962**

Striapollenites saccatus Bharad. 1962

Pl. 11, Fig. 153

Remarks — The specimens observed here are bisaccate and yellowish brown in colour, size 105-136 μ. The central body is vertically oval with one end acute and the other truncate. On the proximal side of the body there are 6-8 vertical striations which are mostly simple, rarely forked. Distally the bladders are inclined forming a boat-shaped, bladder-free area. Bladders are subspherical, intrareticulate with medium-sized meshes measuring from 1 to 2·5 μ.

Striapollenites obliquus sp. nov.

Pl. 11, Fig. 155; Pl. 12, Fig. 156

Holotype — Pl. 11, Fig. 155.

Diagnosis — Size 124-150 μ, central body vertically spindle-oval, proximally with 10-15 vertically oblique striations. Distally a prominent biconvex sulcus present.

Description — Yellowish brown, bisaccate, diploxylonoid pollengrains with a prominent spindle-oval central body. Holotype 150 μ. Central body measuring 48-66 μ × 64-90 μ; exine intramicroreticulate; proximally 10-15 vertically oblique striations present; distally an up to 12 μ wide biconvex sulcus present. Bladders ± hemispherical, with small- to medium-sized intrareticulation.

Comparison — *S. saccatus*, the genotype, differs in having lesser number of striations and a boat-shaped bladder free area distally.

Striapollenites sp.

Pl. 11, Fig. 154

Description — Golden yellow, subcircular to squarish in shape, ± 105 μ. Central body vertically oval with 5-6 simple, vertically straight striations on the proximal side. Bladder completely enveloping the body excepting a notch on one of the lateral sides indicating a bisaccate tendency.

Comparison — *Striapollenites saccatus* and *S. obliquus* are distinctly bisaccate whereas the present species is monosaccate with a notch on one of the lateral sides.

***Distriatites* Bharad. 1962**

Distriatites insolitus sp. nov.

Pl. 12, Figs. 157-158

Holotype — Pl. 12, Fig. 157.

Diagnosis — Diploxylonoid, 110-140 μ. Central body oval to subcircular with 8-12 proximal, horizontal, and 4-6 distal, vertical striations; exine intramicroreticulate. Distally bladder-free area broad.

Description — Golden yellow with a prominent, dark central body. Holotype 138 μ. Central body oval to subcircular with a thickened margin, proximally bearing 8-12 horizontal striations, sometimes forked and distally 4-6 vertical striations; exine intramicroreticulate. Bladders hemispherical, attached laterally leaving an up to 25 μ wide channel distally in the centre of the body, intrareticulate with meshes of variable sizes.

Comparison — *Distriatites bilateris*, the genotype, is distinctly haploxylonoid and possesses ± 7 striations both proximally as well as distally. The present species distinguishes in its distinctly diploxylonoid nature and a prominent bladder-free area distally on the body.

Distriatites sp.

Pl. 12, Fig. 159

Description — Light brown, diploxylonoid, bilateral pollengrain. Size ± 120 μ. Central body subcircular, ± 46 × 50 μ, bearing-8-10 horizontal striations proximally, and 5-6 vertically oblique striations with some cross-partitions on intramicroreticulate exine distally. Bladder attachment ill-defined, bladders ± hemispherical with medium-sized meshwork.

Comparison — *Distriatites bilateris* differs from the present specimen in being haploxylonoid and in possessing straight, vertical and horizontal striations on the two sides of the central body. The specimens included in *D. insolitus* are bigger in size and the vertical striations are devoid of any cross-partitions. The present specimen distinguishes in being smaller in size, diploxylonoid and in possessing vertically oblique, cross partitioned striations distally and horizontal striations on the proximal side.

Infraturma — *Disacciatrileti* (Lesch.) Pot. 1958

***Sulcatisporites* (Lesch.) Bharad. 1962**

Sulcatisporites sp. A

Pl. 12, Fig. 160

Description — Specimens bisaccate and yellowish brown in colour. Horizontal axis ranging from 130-146 μ in size, but most of the specimens within the size range 132-140 μ. Vertical axis 70-100 μ. Central body elliptical, more like a spindle with a long vertical axis and a shorter horizontal axis. Exine ornamentation intramicroreticulate. Distal sulcus 8-18 μ broad, apparent by its thinner exine and usually having a median, vertical fold. In all specimens of *Sulcatisporites* sp. A, body differentiated by the dense nature and the sulcus by its lighter nature. Bladders subcircular, intrareticulate with medium- to big-sized, incomplete meshes ranging in size from 1-4 μ.

Comparison — *Sulcatisporites ovatus* is much smaller in size and has a comparatively less defined central body.

Sulcatisporites ovatus (B. & H.) Bharad. 1962

Pl. 12, Fig. 162

Remarks — The specimens of *Sulcatisporites ovatus* studied are bisaccate, bilateral and light yellow in colour. The overall size of the horizontal axis ranges from 30-65 μ and the vertical axis measuring 22-60 μ. Central body is vertically oval, outline faintly discernible, nonstriated and exine intramicroreticulate. Distally a narrow 3-4 μ wide bladder-free area present; bladders subspherical, intrareticulate with complete, small-sized (0·5-1·0 μ) meshes.

Closely comparable specimens have been put in *Sulcatisporites* by Leschik (1955). Balme and Hennelly (1955) have referred apparently similar forms to *Florinites* (*F. ovatus*). However, on the basis of a distinct disaccate nature Hart (1960) referred such forms to *Vesicaspora* as *V. ovata*. Now Jansonius (1961) has merged *Sulcatisporites* and *V. ovata* into *Alisporites*. Since the overall shape of the specimens studied by Bharadwaj (1962) is oval to circular and has a very thin central body which is in contrast to *Alisporites*, he has put them in *Sulcatisporites* as *S. ovatus*.

Sulcatisporites sp. B.

Pl. 12, Fig. 161

Description — Yellowish brown with a ± subcircular shape. Size range 125-140 μ. Central body outline hardly discernible. Bladders hemispherical and placed very close to each other forming an up to 8 μ wide channel in the centre broadening at the poles laterally. Bladders intrareticulate with comparatively smaller meshes in the centre than at the margin.

Comparison — *Sulcatisporites interpositus*, the genotype, distinguishes from the present species in possessing a more well-defined sulcus. *S.* sp. A, and *S. ovatus* differ in having comparatively well-defined central body and a broader bladder-free area distally.

***Vesicaspora* Schemel 1951**

Vesicaspora sp.

Pl. 12, Fig. 163

Description — Bilateral, bisaccate pollengrains with narrow lateral connection of the bladders. Central body ± circular, exine imperfectly intramicroreticulate, bladders laterally widely removed, distally inclined leaving a 28-50 μ wide space between them.

Turma — *Polyplicates* Erdt. 1952

***Welwitschiapites* Bolchowitina 1953**

Welwitschiapites tenuis sp. nov.

Pl. 12, Figs. 164-165

Holotype — Bharad. 1960; Pl. 5, Fig. 90.

Diagnosis — Oblong, 72-122 μ. Exine ± 2 μ thick, intrabaculate with 6-10 longitudinal striations.

Description — Yellowish brown, oblong pollengrains. Holotype 56 × 98 μ. Pollengrains with prominent longitudinal grooves numbering 6-10, but in the holotype 6 grooves seen bifurcating sometimes.

Remarks — *Welwitschiapites tenuis* is the first species of the genus being described from Lower Gondwana horizons.

Welwitschiapites extansus sp. nov.

Pl. 12, Figs. 166-167

Holotype — Pl. 12, Fig. 166.

Diagnosis — Oval to subcircular, 36-60 μ with 6-8 longitudinal striations running parallelly, rarely bifurcating. Exine coarsely intrabaculate.

Description — Light brown, oval to subcircular pollengrains. Holotype 54 × 44 μ. Proximally 6-8 striations running parallel to each other from end to end, and anastomosing very rarely. Exine coarsely intrabaculate.

Comparison — *W. tenuis* is bigger in size, and possesses 6-10 striations which are generally forked. *W. extansus* distinguishes in possessing a coarsely intrabaculate exine, smaller size and simple striations spread out through out the breadth of the grain.

Gnetaceaepollenites Thiergart 1938

Cf. *Gnetaceaepollenites sp.*

Pl. 12, Fig. 168

Description — Yellowish brown and oblong in shape. Size range from 86-135 μ. Two prominent folds generally present on the exine along with 3-5 vertical striations. Exine up to 2 μ thick, intrabaculate, appearing in lower magnifications as punctate but on the *extrema lineamenta* intrabaculate nature distinct.

Comparison — *G. sinuous* (B. & H.) Bharad., has a distinctly laevigate exine.

Turma — *Monocolpates* Iverson & Troels-Smith 1950

Subturma — Monoptyches (Naum.) Pot. 1958

Decussatisporites Leschik 1955

Remarks — The specimens of *Decussatisporites* illustrated by Leschik (1955; Pl. 5, Fig. 21) have a distinct germinal furrow with both the longitudinal and the transverse striations. The specimens studied here (Pl. 12, Figs. 169-171), also possess the mentioned two types of striations and the germinal furrow which is faintly seen.

Decussatisporites lucifer sp. nov.

Pl. 12, Figs. 169-171

Holotype — Pl. 12, Fig. 169.

Diagnosis — Circular to subcircular, 36-70 μ, ± parallel striations running along the sides of the sulcus and continuing on the other side to run perpendicular to the former direction. Exine 1-2 μ thick, sulcus 9-12 μ wide at the ends.

Description — Golden yellow, circular or subcircular, the former shape being more common. Holotype 50 μ, subcircular, flattened equatorially with 15 horizontal striations on the proximal side and 6 vertical striations on the two long sides of the sulcus distally. Striations closely spaced leaving ± 1·5 μ broad space inbetween them. Specimens variously flattened and distal sulcus sometimes not clearly seen.

Comparison — *Decussatisporites delineatus* Lesch., the genotype, has faint and closely spaced striations and is oval in shape with a distinct but narrower sulcus.

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EXPLANATION OF PLATES

(*All magnifications* × 500)

Plate 1

1. *Leiotriletes* sp.; photo 245/28.
2-5. Cf. *Concavisporites bankotensis* sp. nov.; photo 246/28, 246/29, 246/14, 245/33.
6-8. *Eupunctisporites gravus* sp. nov.; photo 165/36, 246/1, 161/30.
9. *Eupunctisporites* sp.; photo 174/8.
10-12. *Ricaspora granulata* gen. et sp. nov.; photo 134/1, 198/30, 159/29.
13-15. *Calamospora aplata* sp. nov.; photo 173/8, 177/15, 180/5.
16-17 *Calamospora exila* sp. nov.; photo 170/25, 176/27.
18. *Retusotriletes diversiformis* (B. & H.) Bharad.; photo 205/2.
19-22. *Cyclogranisporites gondwanensis* sp. nov.; photo 135/22, 175/5, 162/13, 151/36.
23-24. *Cyclogranisporites* sp.; photo 134/9, 198/19.
25. *Verrucosisporites* sp.; photo 162/22.

Plate 2

26-28. *Lophotriletes rectus* sp. nov.; photo 174/11, 165/22, 246/26.
29. *Lophotriletes* sp.; photo 177/8.
30-33. Cf. *Lophotriletes rarus* sp. nov.; photo 245/17, 245/22, 246/5, 244/5.
34-39. *Horriditriletes curvibaculosus* gen. et sp. nov.; photo 180/2, 159/21, 165/21, 177/9, 168/14, 157/2.
40. *Horriditriletes* sp. A.; photo 244/8.
41-42. *Horriditriletes brevis* sp. nov.; photo 177/7, 180/9.
43. *Horriditriletes* Cf. *ramosus* (B. & H.) comb. nov.; photo 172/14.
44. *Horriditriletes* sp. B.; photo 177/18.
45-46. *Cyclobaculisporites indicus* sp. nov.; photo 173/32, 163/32.
47-49. *Cyclobaculisporites minutus* sp. nov.; photo 158/12, 170/10, 170/11.
50. *Microfoveolatispora* sp.; photo 136/6.
51-53. *Indospora laevigata* sp. nov.; photo 245/19, 246/27, 163/22.
54-56. *Indospora macula* sp. nov.; photo 176/33, 160/18, 163/15.

Plate 3

57-58. *Indospora* sp.; photo 180/7, 245/35.
59-60. *Dictyotriletes invisus* sp. nov.; photo 206/34, 135/24.
61. *Lycopodiumsporites* sp.; photo 151/34.
62. *Gondisporites* sp.; photo 168/7.
63. *Latosporites colliensis* (B. & H.) Bharad.; photo 180/11.

64. *Latosporites* sp.; photo 170/20.
65. *Punctatosporites* sp.; photo 174/16.
66-69. *Verrucososporites gondwanensis* sp. nov.; photo 180/16, 246/7, 151/9, 244/38.
70. Cf. *Nuskoisporites triangularis* (Mehta) Pot. & Lele; photo 321/3.
71-72. Cf. *Nuskoisporites reticulatus* sp. nov.; photo 172/12, 149/11.

PLATE 4

73. *Densipollenites indicus* Bharad., photo 159/15.
74-75. *Densipollenites invisus* sp. nov.; photo 172/13, 169/32.
76. *Densipollenites* sp.; photo 154/24.
77-78. *Striomonosaccites circularis* sp. nov.; photo 136/11, 154/32.
79-80. *Distriomonosaccites ovalis* sp. nov.; photo 159/17, 140/23.

PLATE 5

81. *Platysaccus* sp.; photo 169/22.
82. *Cuneatisporites* sp.; photo 163/8.
83-87. *Striatites notus* sp. nov.; photo 321/16, 283/12, 310/28, 153/19, 283/20.
88-90. *Striatites rhombicus* sp. nov.; photo 171/16, 173/15, 164/4.

PLATE 6

91. *Striatites rhombicus* sp. nov.; photo 281/14.
92-97. *Striatites subtilis* sp. nov.; photo 171/12, 281/16, 280/3, 281/18, 172/31, 169/31.
98-100. *Striatites obtusus* sp. nov.; photo 279/1, 170/16, 155/10.
101-103. *Striatites solitus* sp. nov.; photo 159/6, 165/13, 167/35.

PLATE 7

104. *Striatites solitus* sp. nov.; photo 309/9.
105-107. *Striatites communis* sp. nov.; photo 169/25, 282/3, 310/33.
108-109. *Verticipollenites crassus* sp. nov.; photo 281/10, 281/11.
110-114. *Verticipollenites finitimus* sp. nov.; photo 164/32, 280/37, 173/21, 282/17, 322/22.

PLATE 8

115-117. *Verticipollenites subcircularis* sp. nov.; photo 280/9, 170/9, 168/17.
118. *Verticipollenites gibbosus* Bharad.; photo 168/11.
119-121. *Lahirites singularis* sp. nov.; photo 164/23, 164/26, 163/32.
122-124. *Lahirites incertus* sp. nov.; photo 169/33, 284/26, 169/9.
125. *Lahirites rotundus* sp. nov.; photo 311/31.

PLATE 9

126-127. *Lahirites rotundus* sp. nov.; photo 281/28, 279/20.
128-130. *Lahirites rarus* sp. nov.; photo 157/6, 152/12, 321/6.
131-132. *Lahirites parvus* sp. nov.; photo 169/13, 323/7.
133. *Lahirites* sp.; photo 279/5.
134. *Hindipollenites indicus* Bharad.; photo 280/31.
135-136. *Hindipollenites oblongus* sp. nov.; photo 151/7, 279/22.
137. *Lunatisporites fuscus* Bharad.; photo 168/16.

PLATE 10

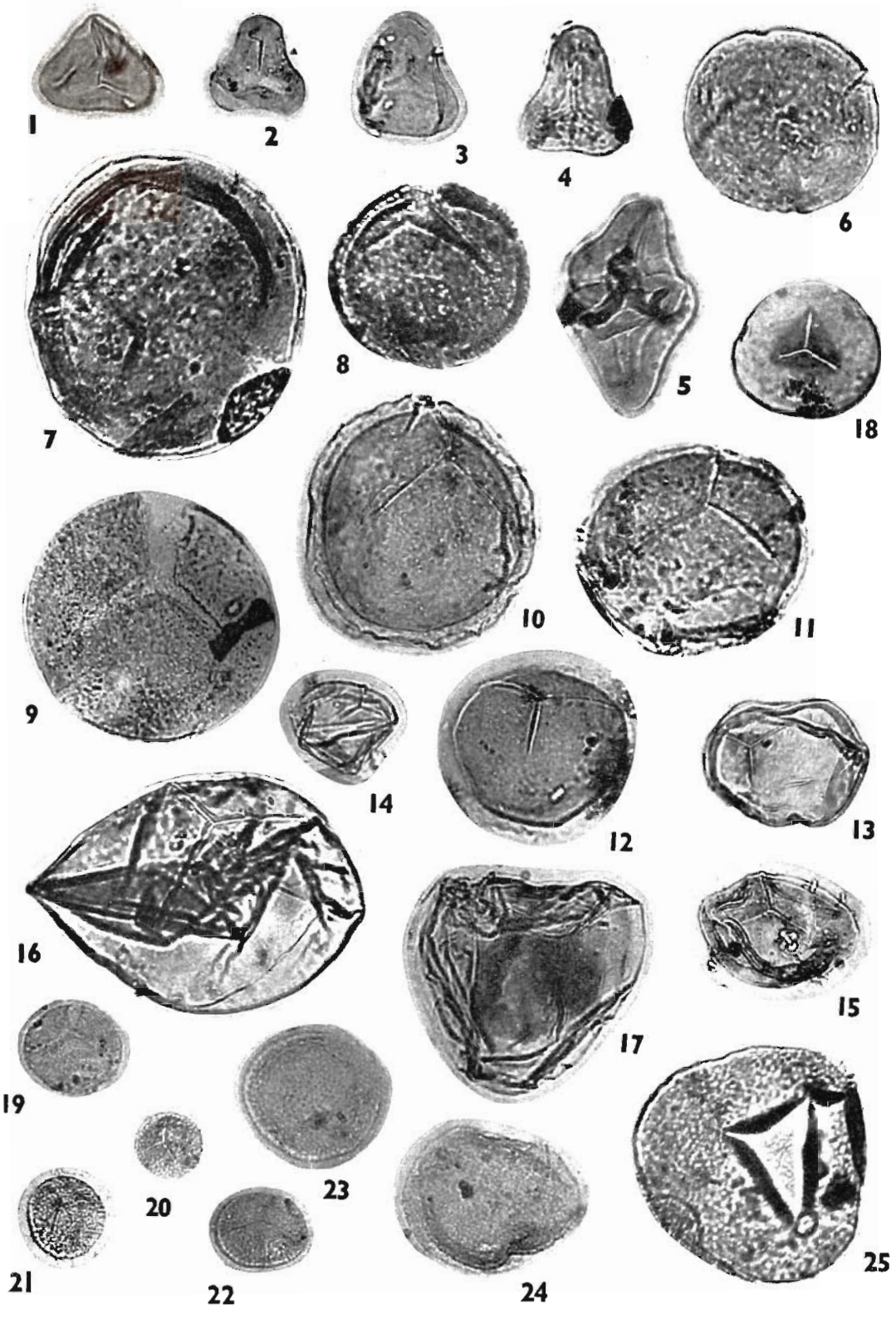
138. *Lunatisporites* sp. A.; photo 171/35.
139. *Lunatisporites* sp. B.; photo 170/22.
140-142 & 146. *Striatopodocarpites decorus* sp. nov.; photo 173/18, 173/17, 176/18, 245/11.
143-145 & 147. *Striatopodocarpites magnificus* sp. nov.; photo 161/6, 170/14, 163/9, 156/16.

PLATE 11

148-149. *Striatopodocarpites diffusus* sp. nov. photo 150/2, 152/32.
150. *Faunipollenites varius* Bharad.; photo 176/12.
151. *Faunipollenites* sp. A.; photo 172/2.
152. *Faunipollenites* sp. B.; photo 150/4.
153. *Striapollenites saccatus* Bharad.; photo 162/31.
154. *Striapollenites* sp.; photo 165/6.
155. *Striapollenites obliquus* sp. nov.; photo 174/18.

PLATE 12

156. *Striapollenites obliquus* sp. nov.; photo 154/31.
157-158. *Distriatites insolitus* sp. nov.; photo 162/6, 167/2.
159. *Distriatites* sp., photo 173/11.
160. *Sulcatisporites* sp. A.; photo 176/5.
161 *Sulcatisporites* sp. B.; photo 154/13.
162. *Sulcatisporites ovatus* (B. & H.) Bharad.; photo 174/14.
163. *Vesicaspora* sp. photo 173/10.
164-165. *Welwitschiapites tenuis* sp. nov., photo 165/18, 180/14.
166-167. *Welwitschiapites extansus* sp. nov.; photo 180/4, 176/30.
168. Cf. *Gnetaceaepollenites* sp.; photo 159/1.
169-171. *Decussatisporites lucifer* sp. nov.; photo 149/25, 180/13, 180/18.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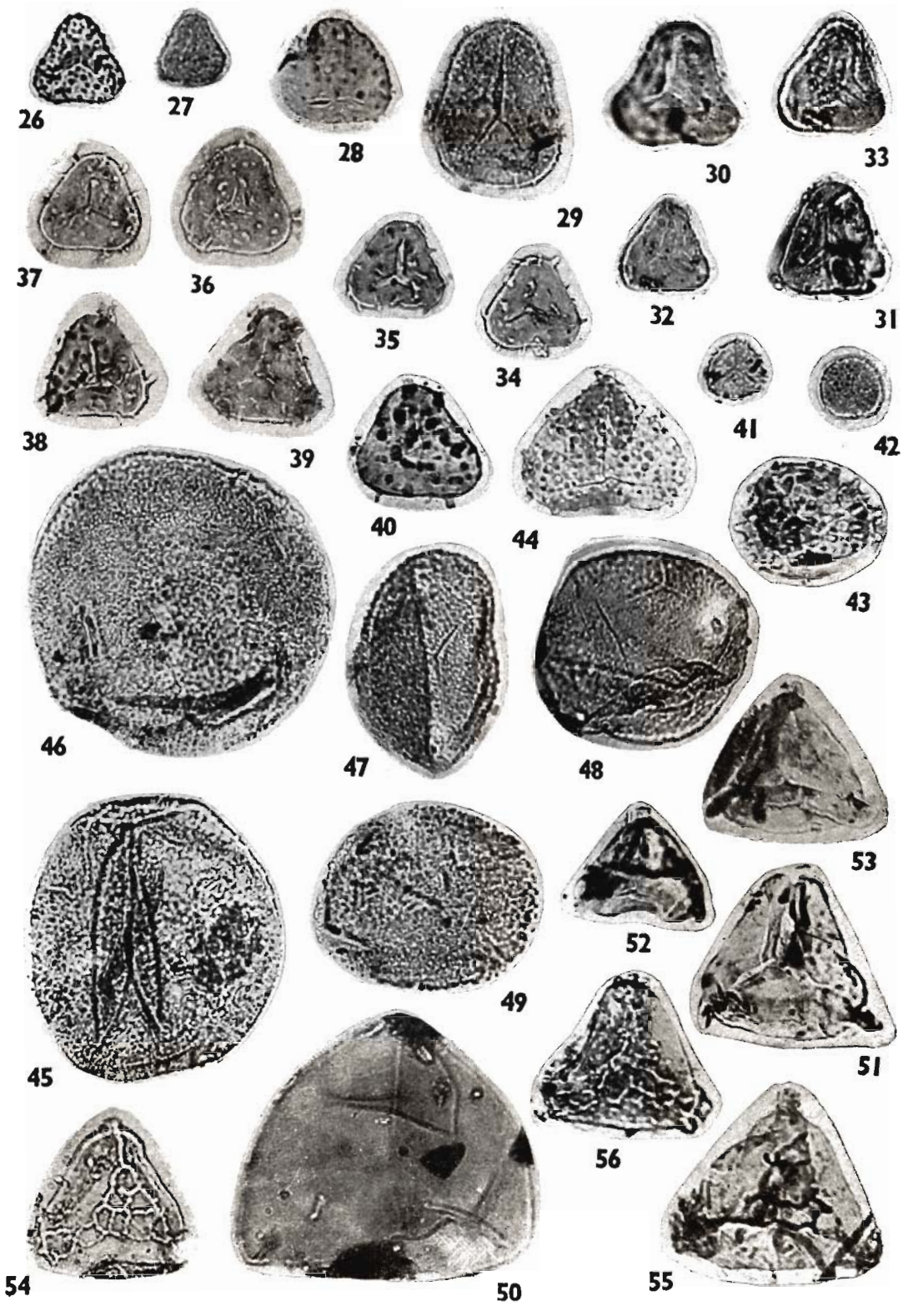
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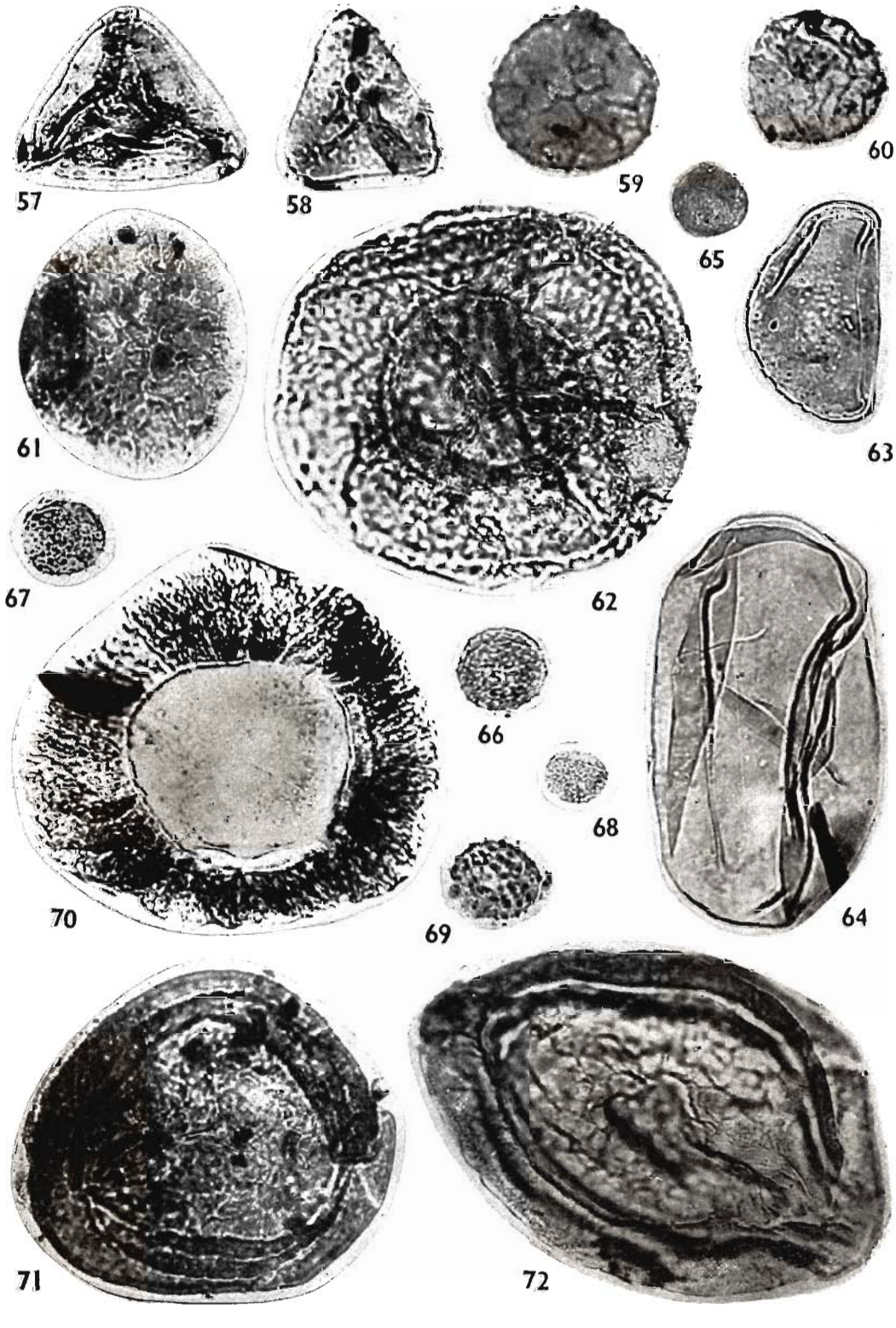
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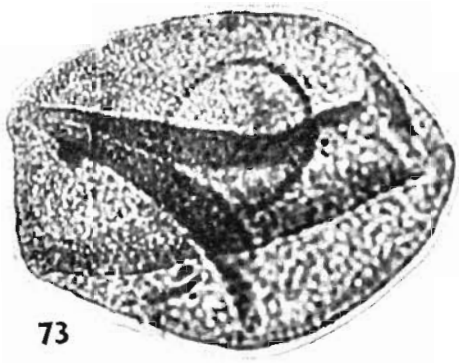
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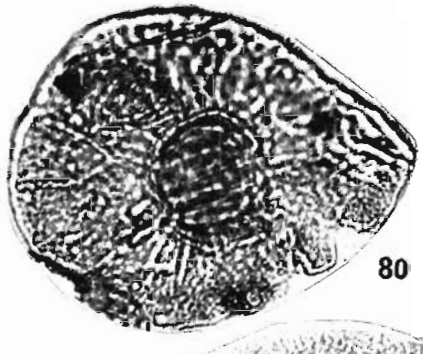
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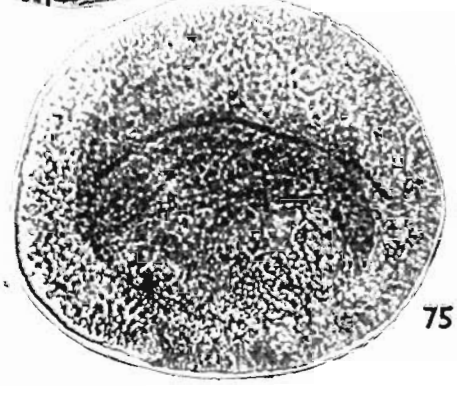
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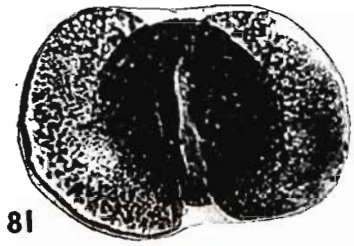
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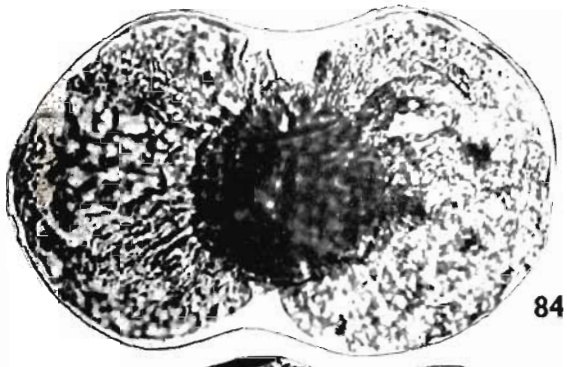
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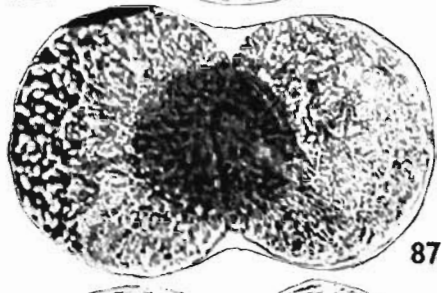
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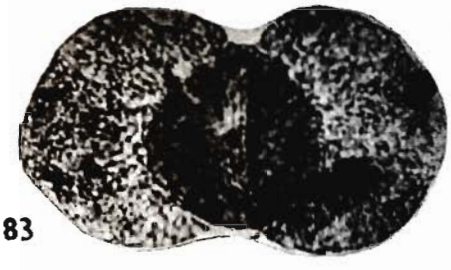
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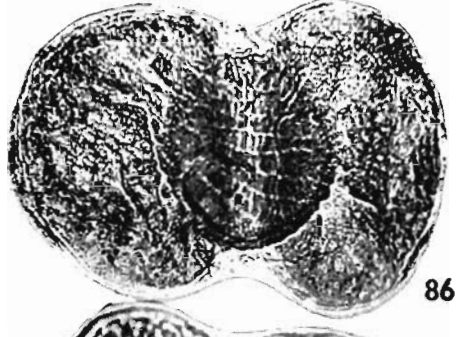
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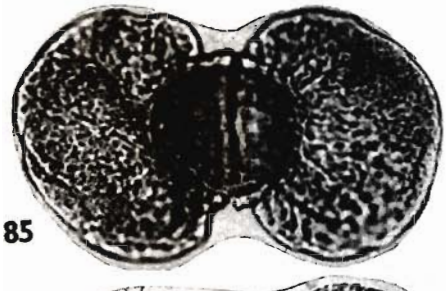
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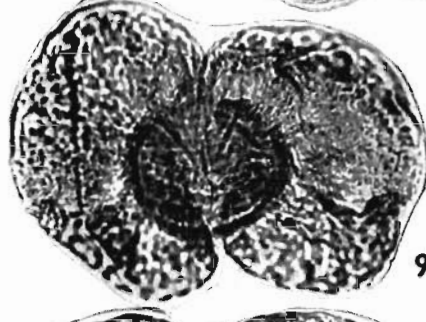
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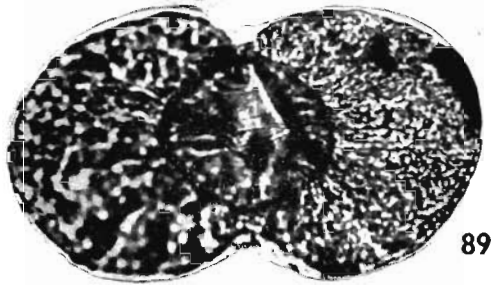
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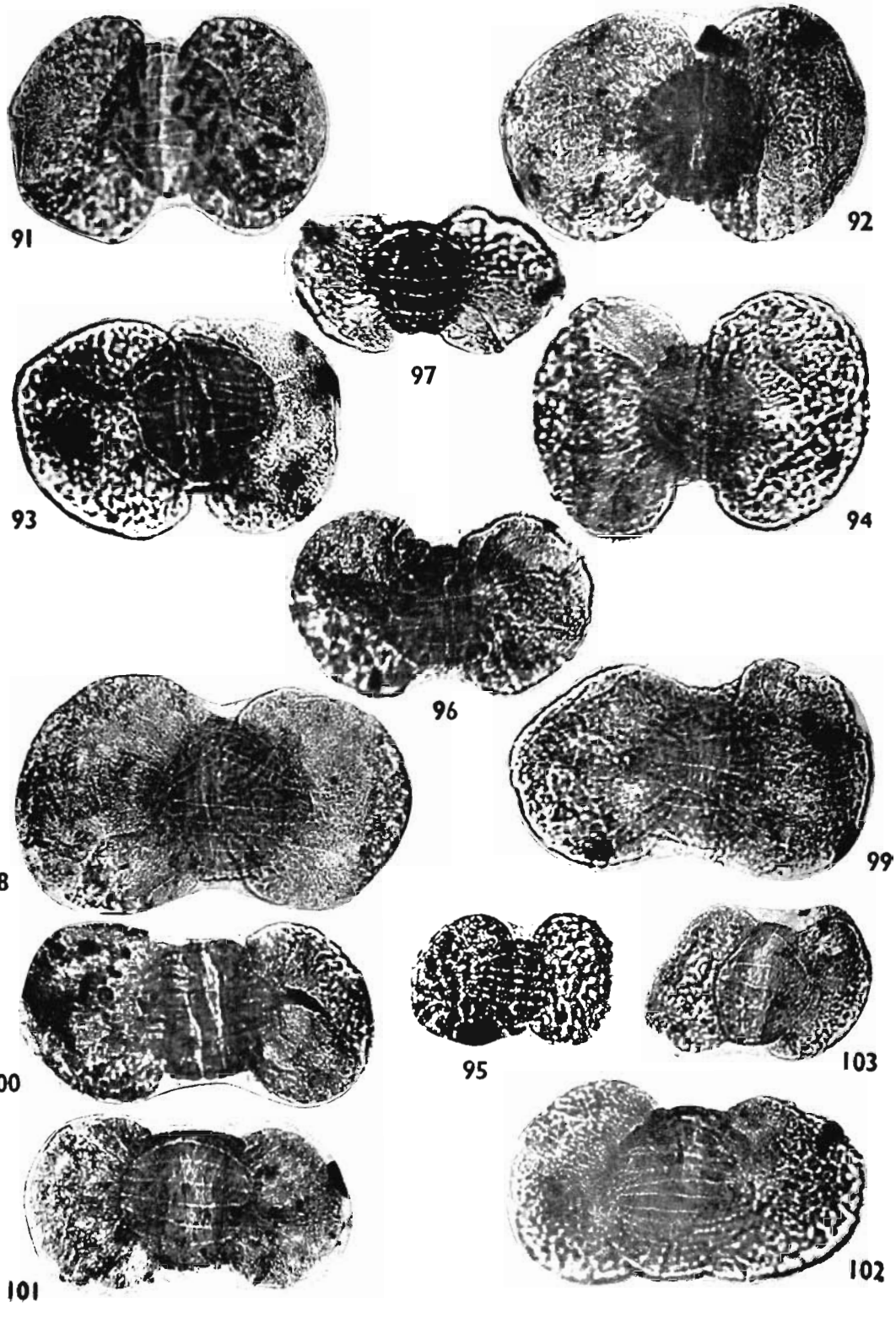
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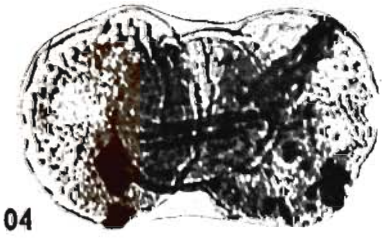
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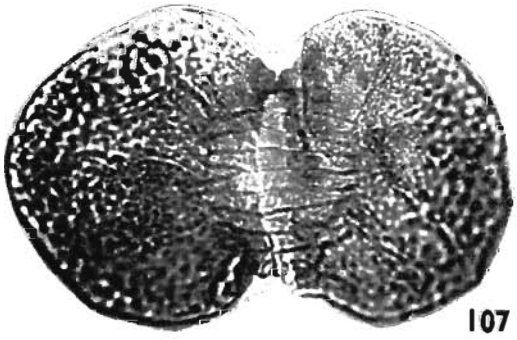
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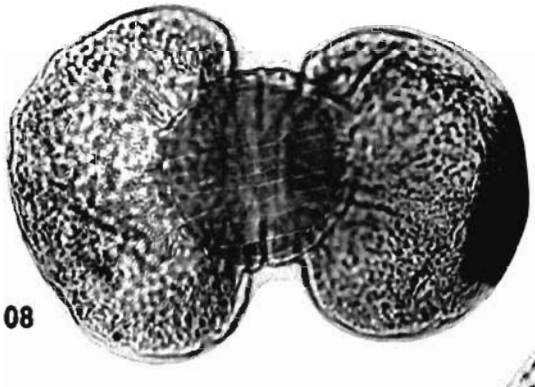
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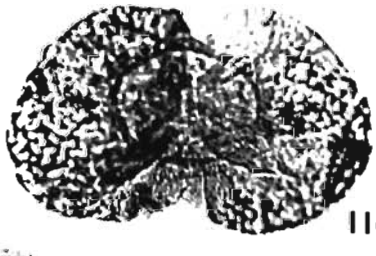
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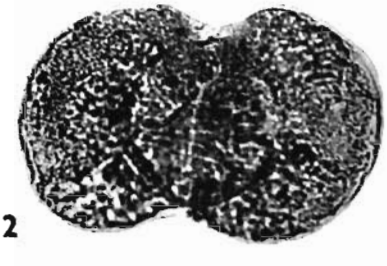
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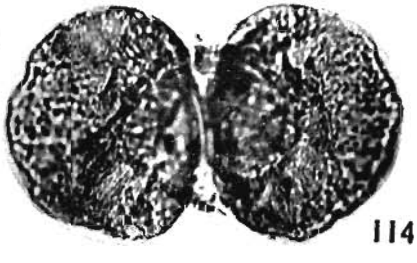
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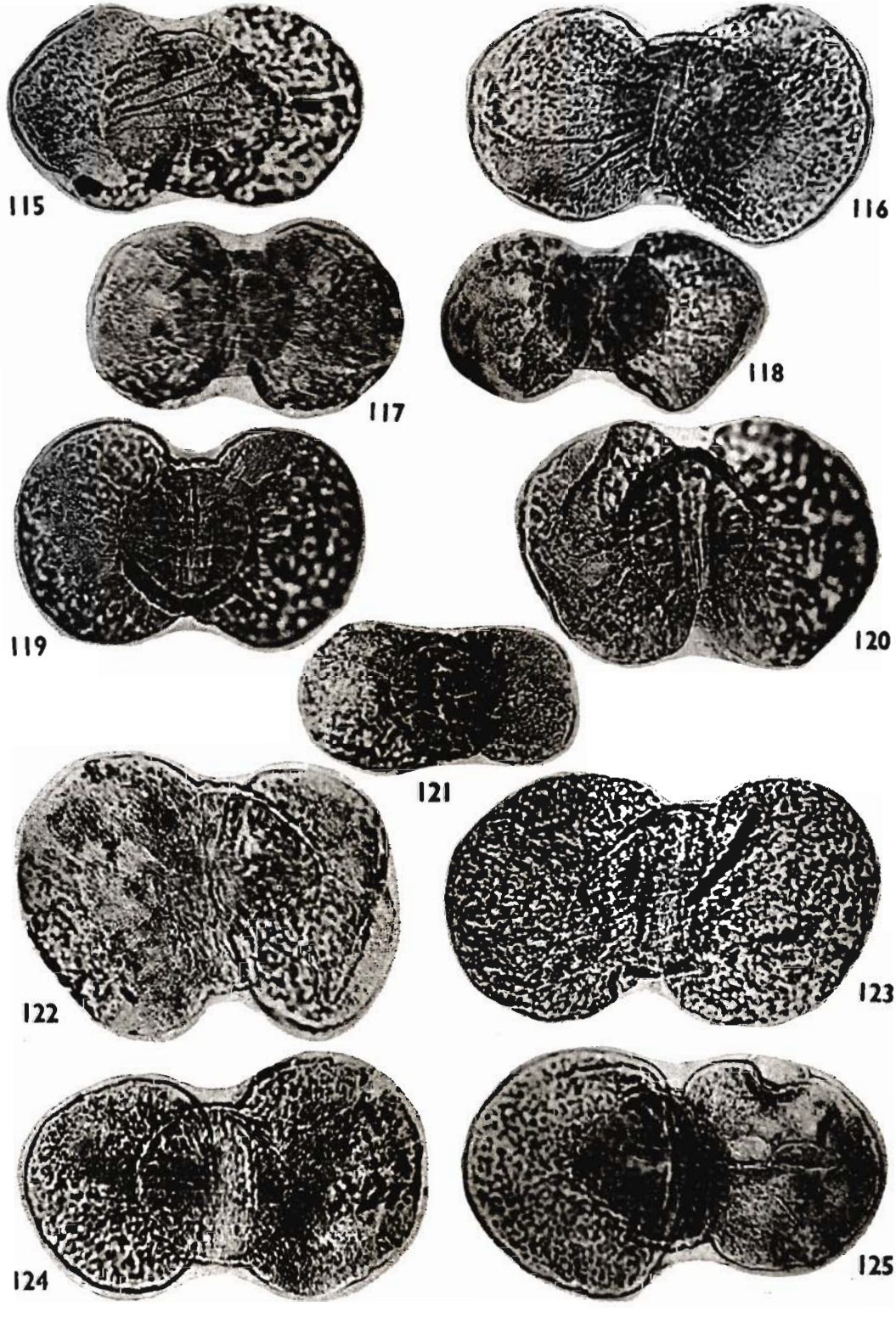
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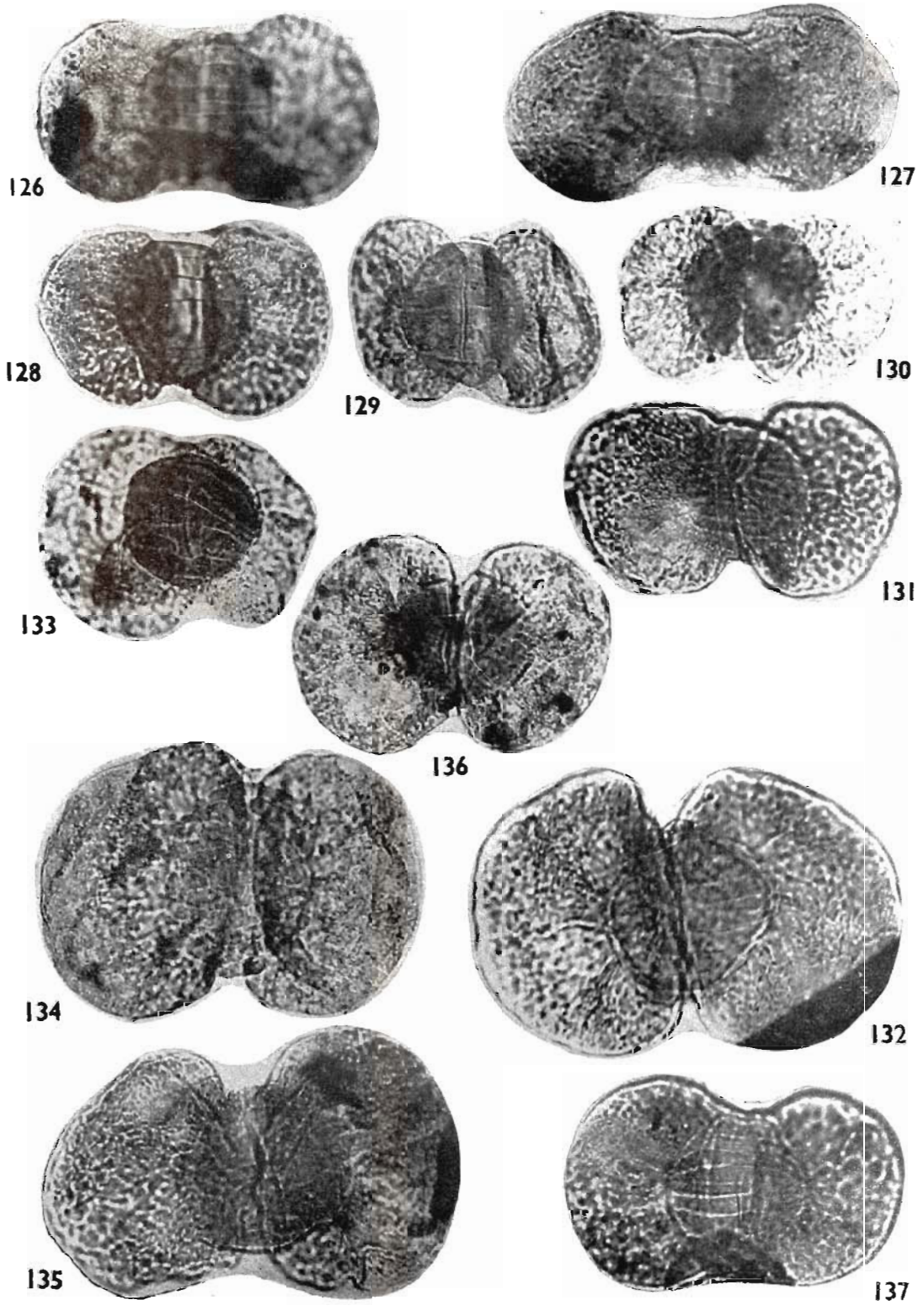
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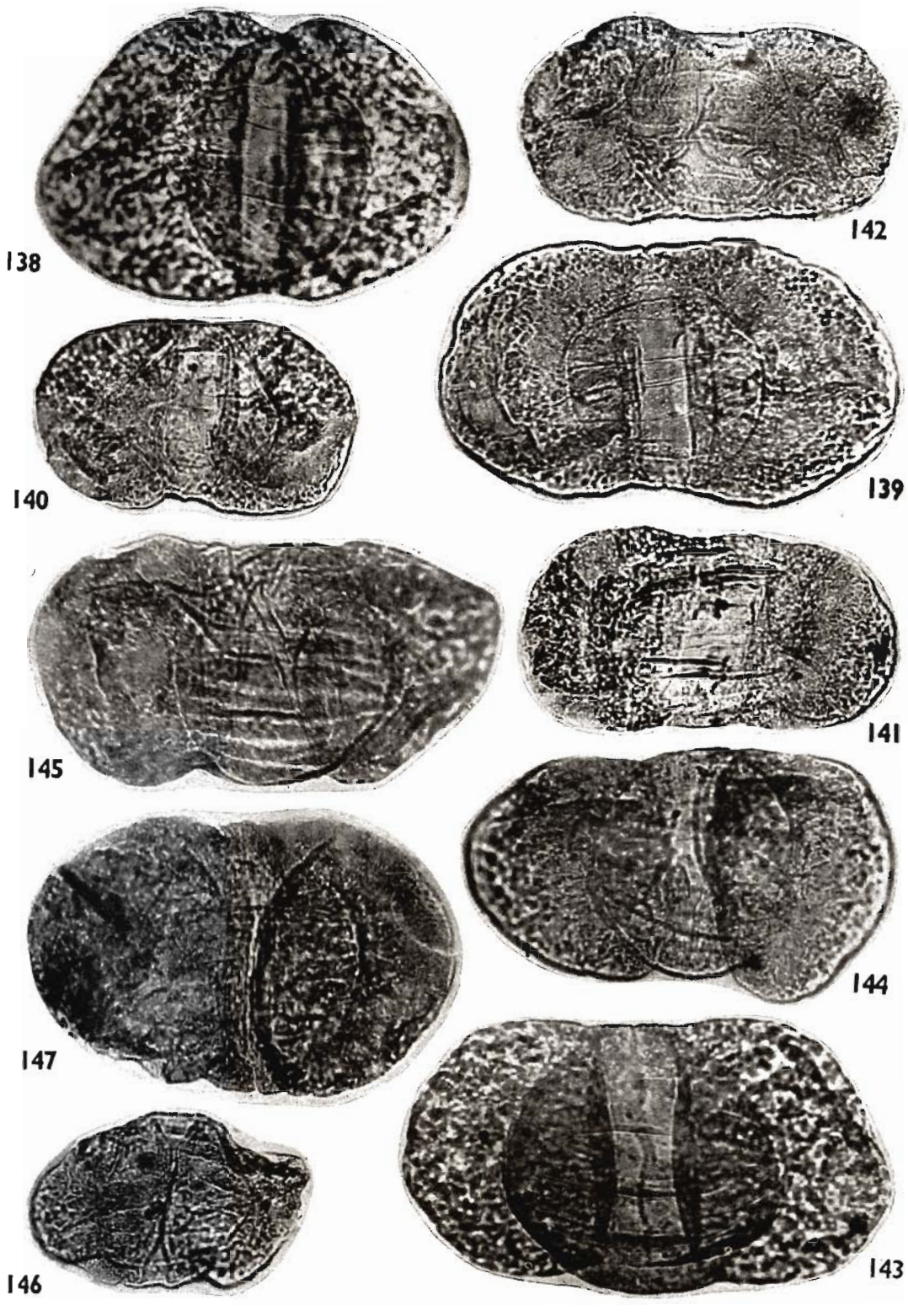
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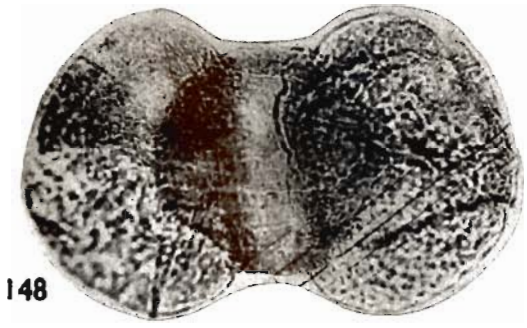

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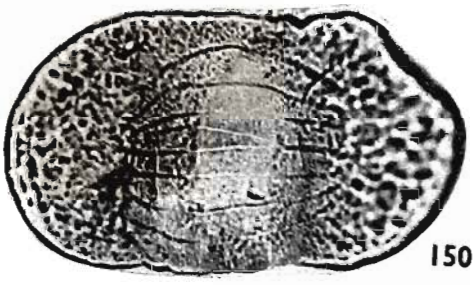

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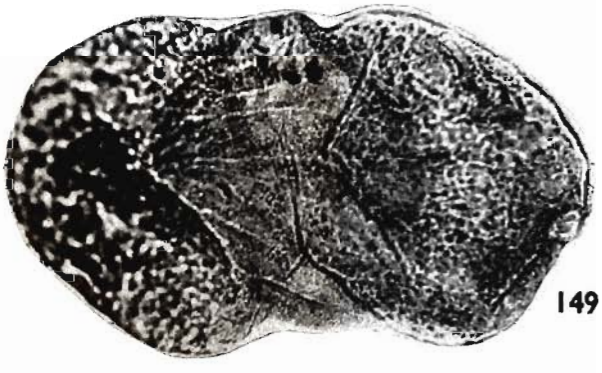

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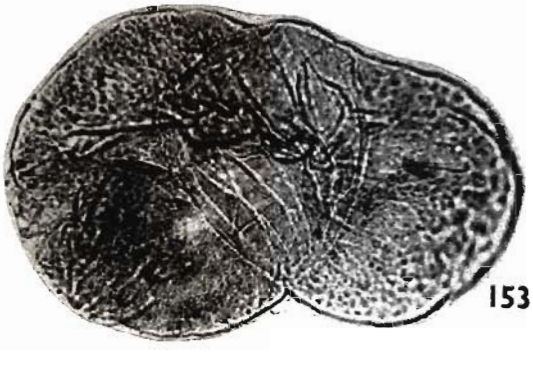

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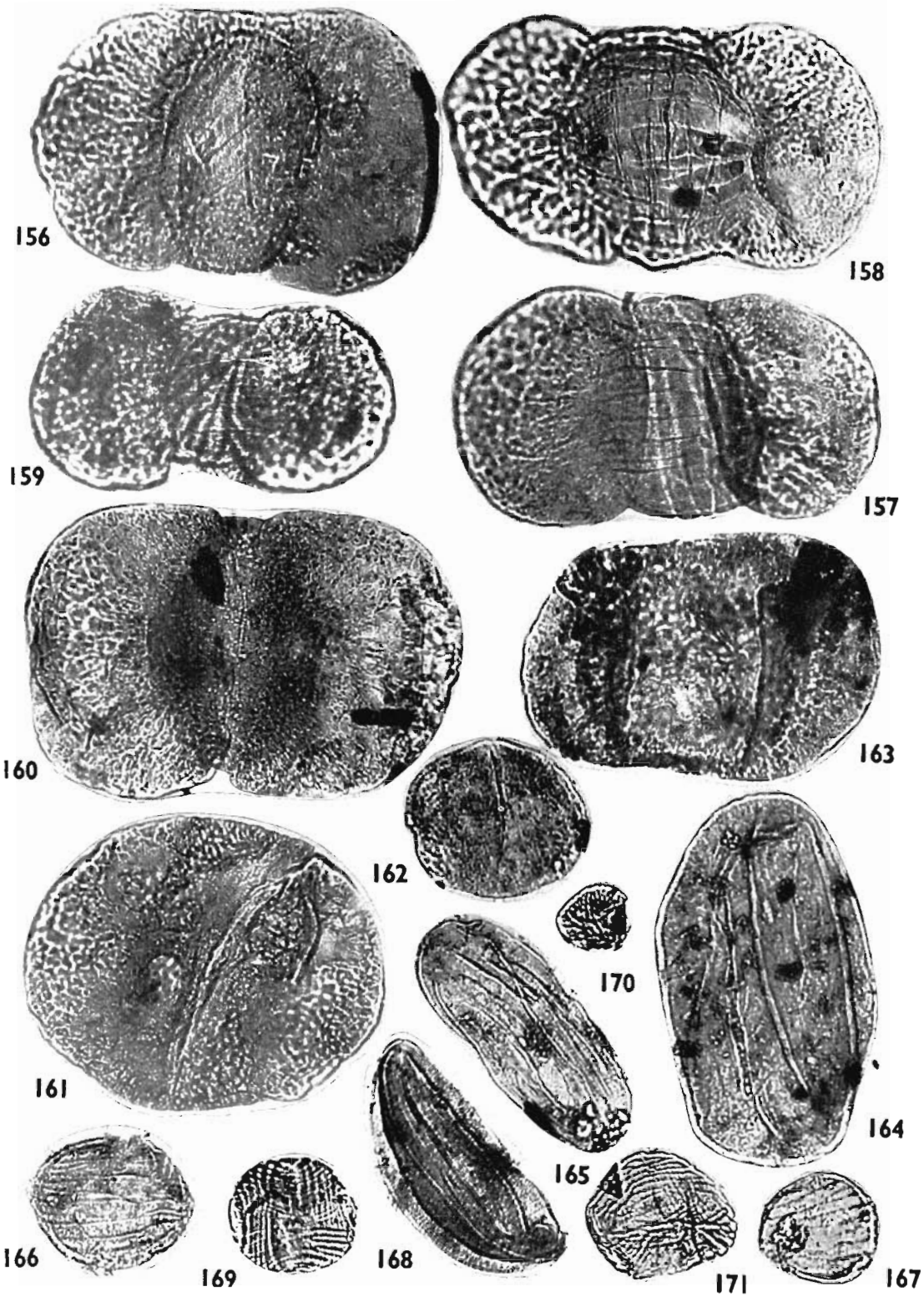
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